INDUSTRIAL ENGINEER

Devoted to the Maintenance and Operation of Electrical and Associated Mechanical Systems in Mills and Factories

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Thanks! Many Thanks!!

You're a Lot of Good Fellows and Just the Kind I Like to Work With

I RECEIVED a lot of Christmas and New Year cards this year, wishing a Merry Christmas and a Happy New Year in the good old-fashioned way. All of these touched the spot far above where I keep my change and made me feel that, although Santa did not bring me a salary increase, I am rich in a thing that money cannot buy: namely, lots of honest-to-goodness friends.

A message I received from M. B. Urquhart of Denver, Colo., struck me as something good and sort of told me that Urquhart must be a good scout. His message was headed "Fellowship" and read:

It's a great thing, O my brothers, for a feller just to lay
His hand upon your shoulder in a friendly sort of way!
It makes a man feel queerish, it makes the teardrops start,
An' you sort o' feel a flutter in the region of the heart;
You can't look up and meet his eyes; you don't know what to say
When his hand is on your shoulder in a friendly sort of way!

It's a great thing, O my brothers, for a feller just to lay
His hand upon your shoulder in a friendly sort of way!
For the world's a curious compound with its honey and its gall,
With its care and bitter crosses; but a good world after all;
An' a good God must have made it—leastways, that is what I say.
When a hand is on my shoulder in a friendly sort of way!

Hundreds of you fellows who have read my stuff during the past three years have laid a hand upon my shoulder in just this friendly sort of way in the nice things you have said in your letters about me and the paper I am associated with. To all of you I want to express my appreciation and simply say that if you like my stuff as well as I like to know that you like it, we're even. Some of you have said a lot and some just a word or two, but I have seen every comment and hereby acknowledge all of them with special thanks to the following:

Nicholas J. Weiss who said: "I wish to take this occasion to thank Practical Pete and the rest of the gang out in Chicago for their efficient, faithful and last, but not least, helpful service through what I may christen The Practical Man's Friend —INDUSTRIAL ENGINEER. May I extend my heartiest good wishes for a Merry Christmas and a prosperous New Year."

C. Otto von Dannenberg, who said: "Tell Practical Pete that INDUSTRIAL ENGINEER is becoming a veritable treasure trove of useful information."

H. J. Achee, who said: "I have subscribed to lots of electrical and mechanical magazines but INDUSTRIAL ENGINEER is the best of them all by a large majority."

H. G. Lechner, who said: "I like the manner in which the various articles in INDUSTRIAL ENGINEER are written. They make you feel as if you were solving the problems with the writer."

Ira A. Bledsoe, who said: "I take pleasure in recommending INDUSTRIAL ENGINEER to my friends."

B. R. Glasscock, who said: "I am interested in motor installations and details of plant equipment as presented in INDUSTRIAL ENGINEER. Practical Pete is always good."

A. B. Lang, who said: "I am pleased with the service you give through INDUSTRIAL ENGINEER. It is a paper I would not be without."

C. E. Christoff, who said: "I have been a subscriber to INDUSTRIAL ENGINEER for two years and I would not do without it if I could possibly get it."

W. J. Schaffer, who said: "I am very much impressed with Practical Pete, but INDUSTRIAL ENGINEER is good all the way through."

W. H. Lewis, who said: "I am interested in the practical departments and anything by Practical Pete."

T. J. Frayno, who said: "INDUSTRIAL ENGINEER is the most practical magazine I have ever been able to get and I have tried them all."

That's enough! All of the rest of you said something equally nice to hear and I acknowledge your letters with blushes, for you have done yourself proud with appreciation that merits more hard work and just the best that in me lies. That you are going to get during 1925.

Practical Pete

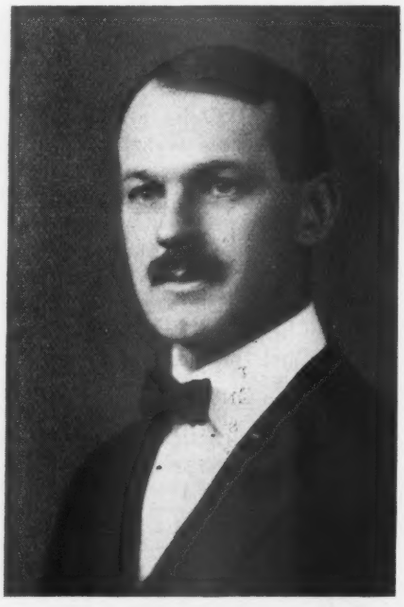
What Maintenance Includes and How It Is Handled

In the Groton and Cortland (N. Y.) Plants of The Corona Typewriter Company, Together With Details of the Work Done and of the Organization That Is Required

By C. D. CORWIN

Works Engineer, Corona Typewriter Co., Inc., Groton, N. Y.

THE maintenance organization in a mill or factory should be responsible for all lines of work, in the entire plant, on which efficient operating conditions depend. This may at first appear to be a very broad statement, but any production man knows to what an extent conditions of machinery, equipment, etc., affect his output and where the responsibility for proper working conditions is divided between several heads, there is always a great tendency to pass the "buck." The chief electrician can best handle all electrical equipment. The master mechanic can best handle all other equipment. In using the title master mechanic, I refer to a man who has practical experience and the better man he is if he has had a technical training. When the size of the plant demands it, there should be various divisions of the work handled, each with its foreman. For instance, machinery maintenance, tool maintenance, building maintenance, factory equipment maintenance, safety work, and so forth. Not all of the work of a maintenance organization can be strictly classified as electrical or mechanical for there is much important work that arises which calls for a knowledge of factory operation and plant construction. This work usually involves important changes, such as relocation of pipe lines and machinery to better facilitate routing of work. The maintenance organization should also have information on various types of roof coverings, concrete floors, removal of obnoxious fumes and wastes, etc.



C. D. Corwin, Works Engineer, Corona Typewriter Company, and President and Manager of the Corona Building and Improvement Company. His maintenance force is shown on the opposite page.

Maintenance and plant operation require men of practically every trade with the possible exception of paper-hangers and stonesetters. The man in charge of maintenance and plant operation should be broad-gaged, for he has as his main duties the selection and organization of the proper men to handle the many diversified problems which go to make up maintenance. He should so organize his force as to properly and efficiently operate the plant and to maintain all of it in first-class condition at all times. He should secure the confidence and co-operation of the men under his charge, to the end that every individual will have the company's interest at heart, and will be on a constant lookout to render better service to all departments. He should establish a suitable inspection routine in order to anticipate failures and to make the necessary repairs and adjustments before serious breakdowns can occur. Time spent on conscientious inspection and prevention of interruption to production pays big dividends and money may be saved and considerable lost time prevented by such regular inspection.

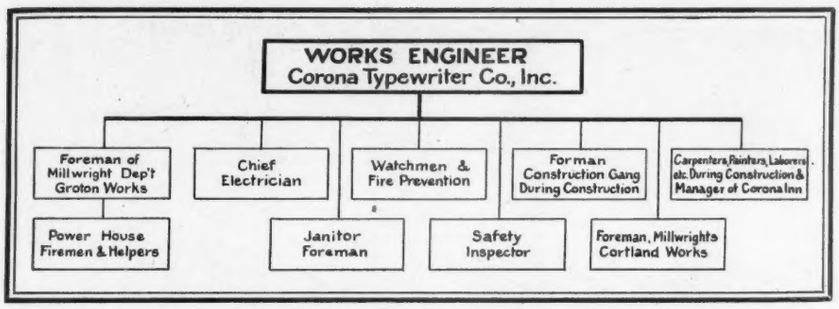
In the plants of the Corona Typewriter Company at Groton and Cortland, N. Y., the following repairs are handled by the maintenance department:

(1) All repairs to buildings and building equipment, including roofs, floors, heating and ventilating systems, plumbing systems, water system, gas system, compressed air system, sprinkler system.

(2) All transmission equipment, such as shafting, countershafts, belting, bearings, etc.

Maintenance Shops at Groton, N. Y. Works of Corona Typewriter Company.

The photograph at the left shows the electrical shop and the one at the right, the millwrights' headquarters. These shops are adjoining.


WORKS ENGINEER
Corona Typewriter Co., Inc.
Foreman of Millwright Dep't Groton Works
Chief Electrician
Watchmen & Fire Prevention
Forman Construction Gang During Construction
Carpenters, Painters, Laborers etc. During Construction & Manager of Corona Inn
Power House Firemen & Helpers
Janitor Foreman
Safety Inspector
Foreman, Millwrights Cortland Works

Organization of the maintenance department showing the divisions of the work headed by foremen.

(3) All water systems, gas, steam and compressed air systems, with the various equipment operated in connection with these systems.

(4) All electrical equipment, including motors, switches, electric ovens, electric heat-treating ovens, etc.

(5) All sheet-metal work, carpenter work and painting work.

The number of men employed varies over a wide range. This is due to the fact that it is the policy of our company to handle practically all of its own construction work of any nature whatsoever. This work has varied from the taking down and rebuilding of a 120-ft. steel stack to the complete designing and construction of a modern steel-frame, brick-veneered manufacturing building containing about 50,000 sq. ft. of floor space. During new construction such as just mentioned, the number of men employed has run as high as 160. Ordinarily, we employ but nine millwrights in the Groton works. These men have been trained so that they can handle practically any type of work which may arise. Naturally some are more expert than others and are, therefore, given a better class of work.

Two electricians handle the electrical work and we have five carpenters regularly employed in our production department, who are subject to call in case their services are required.

Our janitor department consists of a foreman and ten janitors. We also have two night watchmen and one day watchman, with two elevator operators. During the summer months, one day and one night fireman are employed, while during the heating season a helper is required during about one-half of each day.

Steam is generated for industrial and heating purposes and, during the heating season, for operating an air compressor. Our power is purchased from the New York State Gas and Electric Corporation, whose station is about 16 miles away.

At our Cortland plant, we employ a millwright foreman, who has sufficient knowledge of electricity to take care of minor repairs, while the major repairs for this plant are taken care of at our Groton works. For any major electrical construction work our chief electrician is sent to Cortland and the men at Cortland work directly under his supervision. The millwright foreman at the Cortland plant has six men, and the janitor work at the plant is taken care of by the services of two men, while a small amount of it is handled by the night watchman.

The firing of the low-pressure boilers at the Cortland plant is also taken care of by men working directly under the millwright foreman.

In our millwright department at Groton are a heavy-duty and light-duty drill press, tool grinder, squaring shears, rolls, crimpers, beaders and forge, while the electrician has a lathe and drill press. Any new work of great refinement is taken care of in our tool room by the tool makers.

Service is the watchword of every employee in the maintenance department and in doing their work they come across many things that are either taken care of immediately or reported back to their foreman.

(*Please turn to page 110*)

Representative Examples of

Changes in Mechanical and Electrical Equipment

Which Have Been Made During the Past Year by Readers of Industrial Engineer, Together with the Reasons Therefor

IN PRACTICALLY all industrial plants more or less radical changes in the kind and type of equipment used are constantly taking place. There are several reasons for making such changes, although the necessity of producing goods at the highest possible efficiency in order that the resultant low costs may enable competition to be successfully met, is one of the most important reasons.

In the same manner continuity of operation, which means freedom from delays and shutdowns that inevitably cause annoying and perhaps serious losses of production, is likewise of great importance. It is often the deciding factor when alterations in equipment are contemplated or new equipment of any kind is to be selected.

Low operating and maintenance costs are considerations which frequently influence the decision of the operating man in favor of a particular type or make of equipment, or method of drive, control or operation. The desire to obtain lower operating and maintenance costs may cause him to replace existing equipment or methods with others which seem to offer worth-while advantages in these respects.

Manufacturers of industrial equipment of all kinds spend yearly large sums of money in their efforts to meet the insistent demand for equipment which will make possible greater production at lower unit costs. As a result of this study and effort new designs of equipment are constantly being brought out. The character and extent of these new developments which have been made during the past year are outlined in other leading articles in this issue of INDUSTRIAL ENGINEER.

In consequence of this continual evolution of new and better devices a good deal of equipment becomes, within a few years, more or less obsolete in the sense that later designs offer improved operating characteristics of one sort or another that make for greater all-around efficiency.

The following comments by operating men on the changes which were made during the past year in the plants under their control are representative in that they show the kind of changes that are constantly being made in industrial plants.

These comments are an index to the kind of thinking that is being done by those who have the important responsibility of keeping production going at the maximum rate by selecting equipment that is suited to the operating conditions and maintaining it at the top-notch of efficiency through the medium of well-organized inspection and repair methods that are properly and consistently carried out.

H. D. Fisher, Plant Engineer, New Haven Pulp and Board Company, New Haven, Conn.—During the past 18 months we have installed individual motors on all jordans, driving them directly through flexible, telescopic couplings, as shown in Fig. 2, and on beaters driven in pairs by silent chains. These individual drives replaced two group drives, one driven by a Corliss engine and the other by a 400-hp. motor. The advantages sought were: To eliminate belt trouble and the resultant expense; to increase reliability of operation by confining trouble to single units; and saving of power by making it possible to shut down units which were not needed.

Smaller machines, taking up to 6-in. or 8-in. belts, which are near to each other and operate together are driven in groups to reduce the number of small motors, control equipment and wiring to be cared for. However, small machines which are somewhat isolated, and particularly those which are not in continuous use, are individually motor-driven.

We have not gone extensively into the use of ball bearings, as the heavy patterns required for our work would be very expensive and the possible savings in friction load comparatively small. Further, until our men are more familiar with the signs which these bearings give of impending trouble we fear that we would have a disproportionate number of failures. We attribute the rather excessive trouble with those which we now have to the fact that incipient trouble is not recognized and remedied before it becomes serious.

We have devoted a good deal of attention to improving our methods of handling materials, especially from vessels. Fig. 1 shows the elevated runway leading into the pulp storage shed, and a lowered part of the landing platform which is set at the height of one bale above the level of the platform of the electric lift truck, so that the first layer of bales is rolled down onto the platform, the next layer is placed directly on top of these and only the top layers have to be lifted. By the use of a double-drum hoisting engine with the load line led from the derrick boom so as to swing it in over the platform, and a guy line to a block on the vessel and back to the other drum, the hoist operator can control to a nicety the landing of the bales.

Our biggest savings have been made in coal- and ash-handling equipment. Coal is stocked by the belt conveyor equipment shown in Fig. 3, the inclined conveyor swinging on a pivot so as to cover the whole yard. Owing to its ability to dispose of coal as fast as it is unloaded, this conveyor has reduced the unloading time about 50 per cent and cut the cost about 30 per cent. A steam-jet ash conveyor has been replaced by a drag chain and bucket elevator, thereby reducing the peak load on the boilers by about 200 hp., with a considerable saving in coal. This outfit has also greatly reduced the amount of dust given off from the ashes as these can now be wet down, whereas formerly they had to be handled dry. Repair expense has likewise been reduced, as with steady use the pipe of the steam-jet conveyor, especially the portion just beyond the nozzles required frequent replacement. On the other hand, after many months of service the chains and troughs of the present equipment do not show serious wear.

The most serious problem under consideration at the present time is that of obtaining improved heat balance, increasing the amount of dryer surface so as to eliminate the necessity of using live steam in the dryers and also to reduce the number of direct steam-driven auxiliaries and increase the efficiency of those which are absolutely necessary so that there will be no excess of exhaust steam above that required for paper drying. This usually means the substitution of motors, as the development of 1 hp. in the main unit requires only about one-third of the steam that it does in the case of a small turbine running on a throttling governor.

Most changes must be pretty carefully planned in order to be sure that the expenditure will be justified and be commercially profitable. As a general proposition, I believe that the substitution of Corliss or other automatic cut-off engines for plain slide-valve, variable-speed engines; remodeling of boiler rooms with stokers adapted to burn a wide variety of coals, particularly the poorer grades; higher steam pressures with superheat; and the use of direct-drive motors with flexible couplings on all rotating apparatus, offer the best field for future progress.

* * * *

Philip C. Jones, Electrical Engineer, The Goodyear Tire and Rubber Company, Inc., Akron, Ohio.—During the past year and a half we have changed our motor specifications so as to require ball bearings on all motors under 25 hp. rating. We have been experimenting with ball bearings for six or seven years, and the step we have now taken is in line with the results of our experience.

A very high percentage of motor repairs was found to be, directly or indirectly, due to bearings. Much of the rewinding done was made necessary by rotors rubbing on the stators, due to low bearings, or to oil-soaked windings, due to careless oiling. With grease-filled ball bearings we find we elimi-

CHANGES IN PRODUCT and in manufacturing processes are of frequent occurrence in industrial works and bring about corresponding changes in the equipment used all along the paths of power service in all departments. Many other changes are the results of the necessity or desire to secure greater efficiency and reliability in the distribution of the power employed. In order to determine the character and extent of these changes in representative plants, readers of INDUSTRIAL ENGINEER were asked to tell (1) what changes were made during the past year in the equipment used in their plants, for the distribution or application of electrical or mechanical power. (2) Changes which are contemplated but have not yet been made. (3) Changes which are considered desirable, but have not been definitely planned.

In this article are given some typical reports by readers of INDUSTRIAL ENGINEER who are in active charge of plant operation and maintenance. These reports indicate clearly the thinking that is being done by operating and maintenance men.

Fig. 1—The landing platform is arranged for easy handling of the raw material by electric truck.

The raw material is delivered in the form of bales by boat onto a landing platform, part of which is lowered to the height of a bale on the platform of the electric truck, by which it is taken to storage. The first layer of bales can thus be rolled directly onto the platform of the truck, the next layer is placed on top of these and only the top layers have to be lifted.

nate a lot of this trouble as well as diminish our oiling expense.

We have made no radical changes in types of motors or controls. The tendency is toward a greater use of d.c. motors. With the increasing use of individual drive and machine operation, speed adjustment becomes increasingly desirable which, at the present time, means the use of dc. motors.

We generate all our energy and do not contemplate doing otherwise. In a plant our size, with a peak load of 30,000 kw. and a 60 per cent load factor, where considerable quantities of steam are used for manufacturing purposes, it is very difficult for a central station to offer to supply energy at a price which would seem attractive.

During the past year we inaugurated the practice of passing all new major equipment, such as motors and transformers, through the Electrical Laboratory for test before taking them into the plant. This has proven well worth while already.

In the way of lighting equipment I can record the tendency toward higher intensities, and also toward the use of daylight lamps. This last is of particular interest. We have found that we can replace a 100-watt type C lamp with a 100-watt C-2 (daylight) lamp and get better results in spite of the absorption in the C-2 globes.

We are working toward increasing standardization and simplification of all electrical work, but changes which we have made or contemplate along this line would require more explanation than space now permits.

* * * *

E. D. Chrisman, Chief Electrician, Lynchburg Foundry Company, Lynchburg, Va.—During the past year, a great many changes have been made in our plant in order that production could be increased, and the high standard of our good products be maintained.

Small three-phase auto starters with pushbutton control have been installed on saws and other small equipment driven by motors up to, and including, 5 hp. rating.

Bandsaws have been motorized in order to do away with long belt drives and countershafts.

Motor-driven saw filers and tool grinders have been installed in the pattern shop in order to do away with hand work. Small portable motor-driven grinders and buffers have been installed in the metal pattern department, doing away with all hand work, such as filing and sanding.

A new motor-driven cinder mill has been put in operation for reclaiming coke and iron from the cupolas of the pipe shop, special foundry, and the plow foundry.

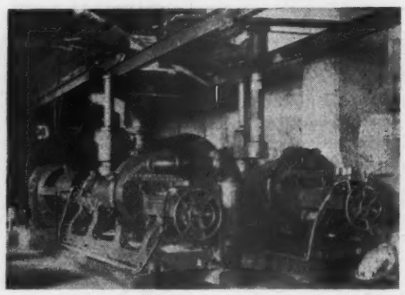


Fig. 2—Jordon engines have been changed to individual drive through flexible, telescopic couplings.

The jordans, as well as the beaters, were formerly group-driven, a Corliss engine and a 400-hp. motor supplying the power for two main group drives. The beaters are now driven in pairs through silent chains.

In the pipe shop we have changed the motor on the trolley of No. 1 crane, from 6 hp. to 10 hp. in order to change the cycle of operation from throwing the flask with the bridge motor to the trolley motion on the shake-out bars.

In the core department, we have placed in operation two Shepard, I-beam, 3,000-lb. hoists, with hook speeds of 80 and 60 ft. per min. at full load. The hoist motor is a 10-hp., series, interpole motor with series brake and the travel is a 2¼-hp. Zabell series, interpole motor with series brake. Both motors are controlled through Shepard pulpit-type controllers working through G. E. protective panels and automatic overload contactors.

In the special foundry, we have installed two Shepard 3-ton, floor-controlled, double-beam cranes, with hook speeds of 40 to 80 ft. per min., full load. The hoist motor is a Crocker-Wheeler, 6-hp. series motor, and the bridge is a 3½-hp. Zabell series motor, both having series brakes. The trolley motion is hand-controlled, and the other two motions are controlled from the floor with Shepard rope-type controllers, which are mounted on the hoist frame.

Plans have been prepared by our plant superintendent, and work has started on the addition to the power house that is to be built in order that we may have greater capacity on the d.c. side of the system.

We are adding another synchronous motor-generator set identical with our other two sets. This machine is to be paralleled on the bars when necessary, and operated independently when the load is light enough for one machine to carry it. The synchronous motor is a G. E., ATI-6, 160-kva., 2,300-volt machine, and will be directly connected to a G. E. MPC, 115-kw., 250-volt d.c. generator, with the excitation circuit taken from the generator end. The machine will be controlled from a panel placed beside it on the main floor, the same as for the other machines, and equipped with auto starter, overload and no-voltage relays, and over-speed trip circuit breaker in series with the auto starter circuit.

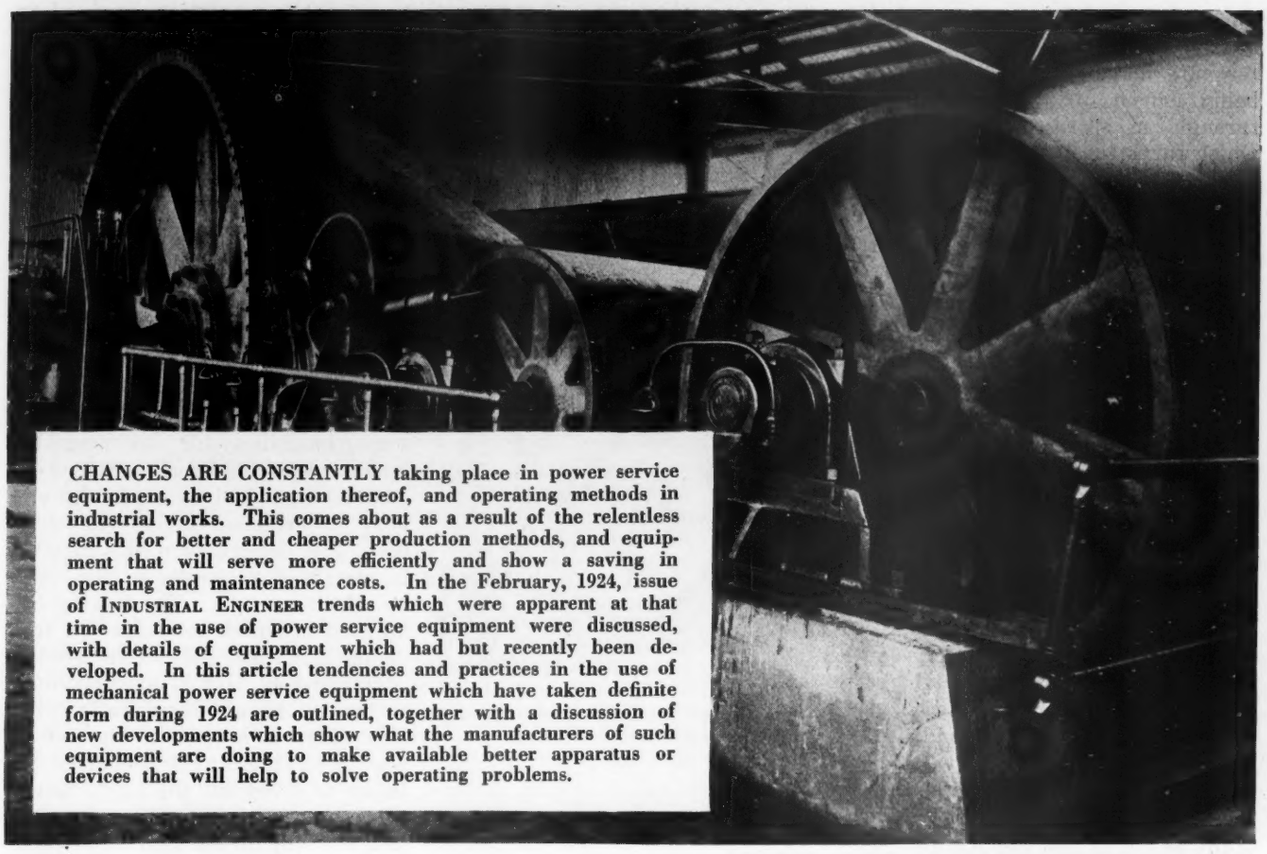
The addition to the d.c. board on the mezzanine floor of the power house will contain a panel with all necessary instruments, circuit breakers, equalizing switches, and ground detectors. Another panel will consist of a voltage regulator, motor-driven, and a stabilator in parallel with the d.c. bus. All the wiring from the main board and panel boards to the machine will be in conduit under the floor. The incoming high-tension lines will be equipped with disconnects and oil breakers, with a separate breaker for each machine in the power house, including the 2-stage air compressors driven by 2,300-volt, 17-hp. motors.

We are contemplating changing some

(*Please turn to page 113*)

Fig. 3—The use of efficient coal- and ash-handling equipment has resulted in large savings.

The installation of a belt conveyor reduced the cost of handling coal 30 per cent, with a 50 per cent reduction in the time required. Similarly, the replacement of a steam-jet ash conveyor by a drag chain and bucket elevator took a heavy load off the boilers and reduced maintenance costs.



CHANGES ARE CONSTANTLY taking place in power service equipment, the application thereof, and operating methods in industrial works. This comes about as a result of the relentless search for better and cheaper production methods, and equipment that will serve more efficiently and show a saving in operating and maintenance costs. In the February, 1924, issue of INDUSTRIAL ENGINEER trends which were apparent at that time in the use of power service equipment were discussed, with details of equipment which had but recently been developed. In this article tendencies and practices in the use of mechanical power service equipment which have taken definite form during 1924 are outlined, together with a discussion of new developments which show what the manufacturers of such equipment are doing to make available better apparatus or devices that will help to solve operating problems.

This shows two leather belts on a Morgan mill driving the finishing stands of a strip mill in a large steel plant. The inner belt receives unusually hard service because of the severe flexing to which it is subjected. On this drive the load fluctuates from zero to maximum within 30 seconds. Acknowledgment is made to Chicago Belting Co., Chicago, Ill., for this illustration.

Trends and New Practices in the Use of

Mechanical Equipment in the Path of Power Service

In Industrial Works, Together With Details of Recent Developments Which Are of Interest to Users of Such Equipment

By G. A. VAN BRUNT
Managing Editor, Industrial Engineer

CURRENT practice in the design of power service equipment and changes in its application show, year after year, definite trends and tendencies which are the results of study of both the manufacturers and the users of such equipment. These developments and the changes which they bring about are definite steps in a never-ending search for designs which will give increased operating efficiency, greater reliability in operation and a reduction in operating costs, and for methods of application that will further the attainment of these ends.

During the past year some new trends of practice have become apparent, while other tendencies which were previously more or less well defined have gained added impetus.

For example, in line with the general increase in the working speeds of production machines, the use of higher lineshaft speeds, which now frequently range from 300 to 400 r.p.m., is very noticeable. Increasing use of ball and roller bearings on line- and countershafts follows closely the adoption of these comparatively high speeds. Belt speeds are likewise being increased, while there is a strong tendency to use smaller pulleys than were formerly employed.

The question of the comparative merits of group and individual drives is always an interesting one. Users of production tools are realizing more and more that neither group nor individual drive is a cure-all for every operating trouble, but that each type of drive has its legitimate place where it can function to better advantage and probably more efficiently than the other. General practice now seems to be to use individual drive whenever it is possible or advisable to do so when machines are operated as separate units. In fact most builders of large machine tools and similar equipment now make provision for mounting a motor directly on the machine, in case it is desired to do this.

Increasing use of individual drive has led to a wide employment of speed reducers as the logical solution of the problem which is presented when it is desired to connect a comparatively high-speed motor

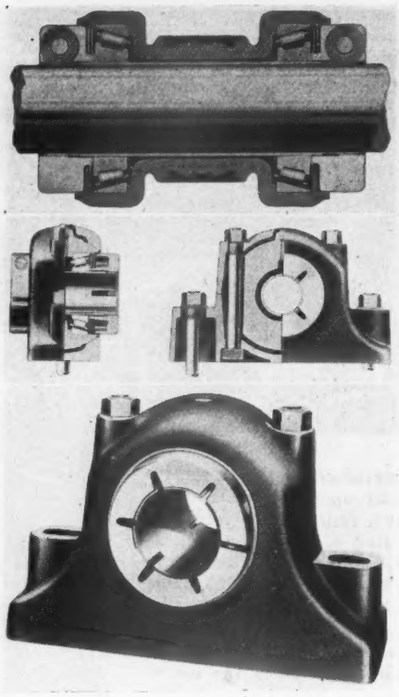
directly to the slower-moving shaft of the production machine. In a few new installations lineshafts are being driven directly by a motor through a speed reduction unit which turns the lineshaft at the desired speed.

In similar fashion, the use of silent chains for both group and individual drives is being applied to new applications. In the case of group drives the chain may be used between the motor and the lineshaft in places where the distance between these is not sufficient to permit the advantageous use of belting. Also, chains are being used to transmit power between two closely adjacent lineshafts and between lineshafts and countershafts. In individual drives, chains are used to couple the motor shaft to the machine shaft, usually with a reduction in speed. In many such instances the distance between shafts is too short to permit the satisfactory use of belts, whereas this condition is no bar to the use of chains, which give the additional advantage of a positive drive. Along the same line belt manufacturers have shown a marked activity in the study of better belt applications and the economies that result in maintaining and reclaiming belts so as to extend their life and increase the efficiency of belt drives. These tendencies have been reported in INDUSTRIAL ENGINEER in serial articles during 1924.

In the following pages a description is given of new developments in the leading items of equipment, which have made possible some of the above-mentioned practices, or have been brought out as a result of them.

Ball, Roller and Sleeve Bearings

The problem of reducing friction in bearings as much as possible has always occupied a good deal of attention on the part of manufacturers and users of power equipment. Friction and power losses are inevitable in any bearing, but they can be kept down to a minimum by the use of properly-designed bearings which are suited to the service conditions. The problem of lubrication from the standpoints of attention required in operation and troubles involving maintenance and repairs is also receiving much attention by both users and manufacturers.



The Dodge-Timken roller-bearing shaft hanger and pillow block.

The upper illustration shows a sectional view of the Timken tapered-roller, shaft hanger bearing. The middle and lower views show the construction of the roller-bearing pillow block and the complete assembly, respectively.

One development of interest which has taken place during the past year is the standardization of ball bearing sizes for industrial motor applications. The need of making the application of ball bearings to general-purpose motors the simplest possible stock proposition has been recognized for some time and the leading manufacturers of these bearings have given this point the most carefuly consideration. Practically every American make of motor was studied and the data thus obtained turned over to a committee of ball bearing engineers who had made a special study of electric motor requirements. The recommendations of this committee were drawn up in the form of a report which was subscribed to by the co-operating companies.

These engineering standards apply only to horizontal, general-purpose electric motors having present Electric Power Club pulley diameters, belt widths, shaft extension diameters, and pulley overhang ratios lying within certain values. The ball bearing sizes recommended by the manufacturers for use in general-purpose motors, together with a more complete account of the work done in this connection, were given on page 503 of the October, 1924, issue of INDUSTRIAL ENGINEER.

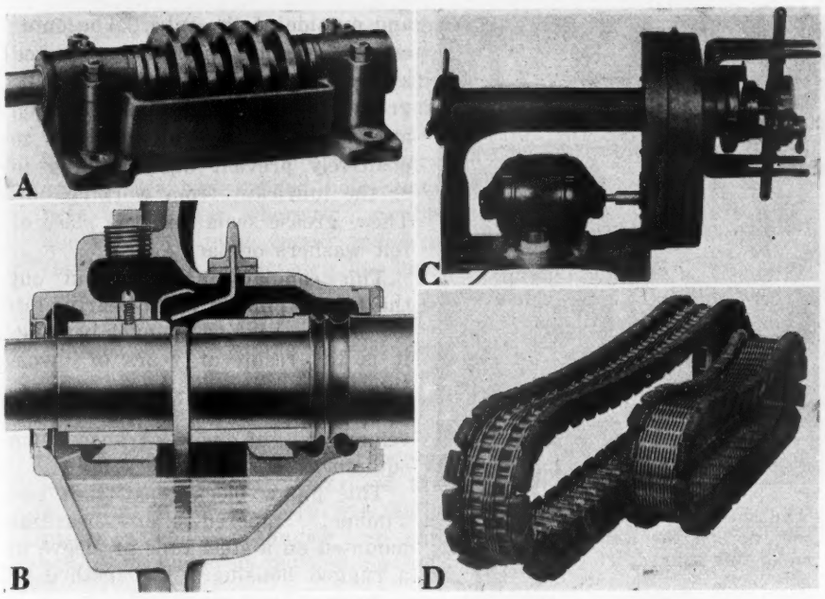
Among the recent improvements in ball and roller bearings, mention may be made of the so-called self-locking collar which has been applied by The Fafnir Bearing Company, New Britain, Conn., to the bearings used in their ball-bearing hanger boxes, pillow blocks and other industrial applications. In any ball-bearing application it is necessary to have the inner race member rotate as an integral unit with the shaft. It is, therefore, necessary to make some provision for securing the inner race to the shaft. Fafnir industrial-type ball bearings have a wide or extended inner race member. The outer end of this member is machined eccentric to the shaft on which it turns. The locking collar which serves to locate the unit on the shaft has one end recessed or counter-bored and is also eccentric to its true bore. Consequently, when this collar is applied to the end of the inner ring, any tendency of the latter to creep on the shaft simply serves, it is claimed, to tighten or lock the ring on the shaft. The collar is securely fastened to the shaft by one or more setscrews.

Standard Steel and Bearings, Inc., Plainville, Conn., has brought out a ball bearing intended primarily for use in the clutch pilot of automobiles, but which it is claimed can be used on any application where the bearing is located in a place that is inaccessible for lubrication, and thus difficult or impossible to oil without disassembling the mechanism.

The novel feature of the bearing is a retainer of sheet steel that is expanded into a groove cut in the outer ring for that purpose. The retainer is made in the usual manner, and when completed is of a diameter that allows it to be dropped into the bearing. A press operation then enlarges the diameter by direct pressure upon the convexed surface so that it cannot be displaced except by driving.

When the mechanism in which the bearing is used is assembled, the latter is packed with suitable grease and so placed that the open side is toward the blank end of the recess. In this position the retainer holds the grease in the bearing.

Chandler Machine Company, Ayer, Mass., has put on the market a roller bearing for use on lineshafts, which consists of a cast-iron housing enclosing two load collars



New developments made during 1924 that cover a wide range of industrial equipment.

At *A* is shown the worm gear box brought out by the W. A. Jones Foundry and Machine Co., for installations in which the use of an enclosed worm gear reduction is not justified. *B*, sealed sleeve bearing for industrial motors, developed by Westinghouse Electric & Manufacturing Co. *C*, pipe cutting and threading machine put out by Oster Manufacturing Co. This machine is driven by a ½-hp. electric motor and will handle pipe up to 2 in. in diameter. *D*, new steel-link, V-belt designed by Reeves Pulley Co., for use on Reeves variable-speed transmissions.

within which the rolls revolve. The bottom of the housing is fitted with two copper oil wipers, one at each end, to prevent the oil drifting along the shaft and out of the bearing.

The load collars, which are split for ease in installation or removal, and held together with strong screws are, it is claimed, made of a special tough metal and are of ample width to carry a heavy load. These load collars have a groove in the middle for housing split, steel spacing rings which keep the rolls in their respective places.

The rolls are said to be made of a special grade of tough, tool steel, finished true to size and cut short enough to leave plenty of room for free running between the shoulders of the load collars. Both ends of the rolls are finished in circular form, so that they act as balls when they touch the shoulders of the load collars.

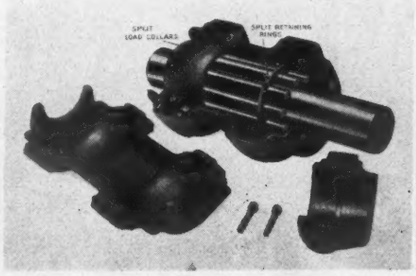
A line of disk and ball bearings designated as the NKA and for which high load-carrying capacity is claimed has been placed on the market by the Wollmar Engineering Corporation, 224 East Forty-second Street, New York, which is the American representative of Nordiska Kullager Aktiebolaget, Gothenburg, Sweden.

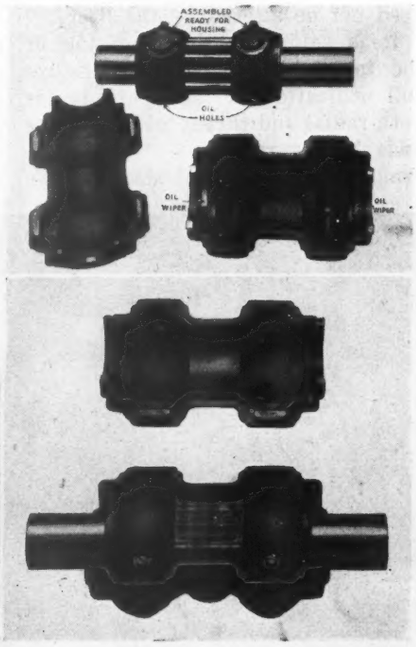
The disk bearing is made up of two race rings, between which rollers having convex race surfaces and flat side surfaces are placed. A feature of the bearing is that the rollers are claimed to be self-guiding.

A feature of the NKA ball bearing, which is available in both radial and thrust types, is the ball cage or separator. This cage is made of spring steel wire, which is looped between each pair of balls, embracing a segment of each ball. This construction is emphasized as minimizing friction, taking up little space, and permitting lubricant to get in between the balls. The balls may be inspected without taking the bearings apart. The ball race grooves are deep and close fit of the balls is intended to provide greater carrying capacity. The method of introducing the balls between the race rings is featured as permitting a large number of balls to be inserted into the bearing.

Details of the Chandler Machine Co.'s roller bearing.

Below, bearing with the upper half of the housing and upper half of one of the load collars removed to show the rolls and one of the roll-retaining rings. The upper view at the right shows the rolls in place in the load collars, ready for assembly in the housing. Lower right, bearing completely assembled except for upper half of housing.





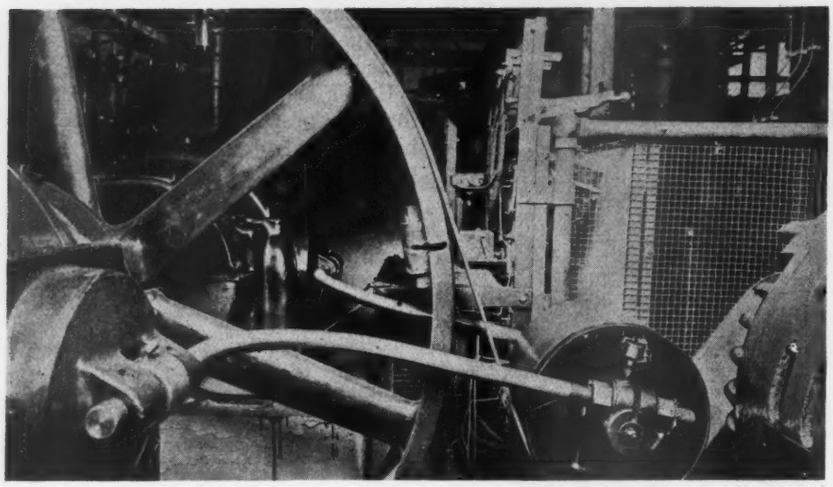
Under the trade name "Excello," the Ex-Cell-O Tool & Manufacturing Co., Detroit, Mich., is now marketing a high-speed ball bearing, licensed under the Snader patent application. This bearing is of the combined radial and thrust type and is designed for speeds up to 50,000 r.p.m.

The ball races are so located in relation to each other that it is claimed the balls are given a spinning motion in addition to the motion of rolling around the center of the shaft. This construction is for the purpose of eliminating the wearing of flat spots or tracks on the balls.

Since the outer races are at an angle, a worn bearing can be salvaged by grinding the inside faces of the outer rings. If the surfaces of the races are excessively pitted or worn, these surfaces can be reground. Bakelite ball separators are used.

Marlin-Rockwell Corporation, successor to Gurney Ball Bearing Company, Jamestown, N. Y., has during the past year further developed and made some additions to its line of Conrad deep-groove ball bearings. They claim that these bearings are particularly suited for high-speed installations and also for applications where the loads are comparatively small but the bearings are likely to be subjected to thrust loads from both directions.

The Dodge Manufacturing Cor-



The short distance between pulley centers and the service conditions make this a hard drive.

This belt drives an air compressor which is fitted with an automatic pressure regulator that starts the motor when the pressure falls to a certain point and stops it when the pressure reaches the upper limit. The motor starts up at about 5-min. intervals and runs for 2 or 3 min. By courtesy of The Graton and Knight Mfg. Co.

poration, Mishawaka, Ind., has placed on the market a new lineshaft bearing embodying the Timken tapered-roller bearing, as well as several new features of construction.

The Timken tapered-roller bearing is constructed on the cone principle which, it is claimed, insures a true rolling action. The bearing itself comprises four parts: a cone or inner race with outside taper, the tapered rollers, a cage or roll retainer and a cup or outer race with inside taper.

The Dodge-Timken roller hanger bearing is a simple bearing. It consists of two Timken, tapered-roller bearings mounted on a ground and slotted steel tube and fitted to an accurately machined housing. The ends of the steel tube are threaded to receive clamping collars designed to secure accurate adjustment of the bearings on the tube. This adjustment is made at the factory and need not be altered by the user.

It is said that the mounting of the tapered-roller bearings insures full utilization of the bearings for both radial and thrust loads. It also adds to the ruggedness of the assembly and is of particular value in resisting the side weave of heavy driving belts.

The method of fastening the steel tube or sleeve to the shaft permits its use on any commercial shafting, by setting up the screws in each of the two clamping collars.

The dust-proof design of this bearing is featured as being of great importance. The sleeve on which the bearings are mounted extends from end to end of the housing. Liberal grease compartments are provided inside of the housing and outside of the tube. The outer ends of the bearings are protected against dust by special metallic grease seals which eliminate friction at this point and are claimed to positively prevent dust working in or the lubricant from working out. These grease seals take the place of felt washers or packing.

This company has also put out the Dodge-Timken roller-bearing pillow block. Like the hanger bearing, it is the result of years of investigation and experience on the part of the Dodge organization in the development of power-transmission equipment.

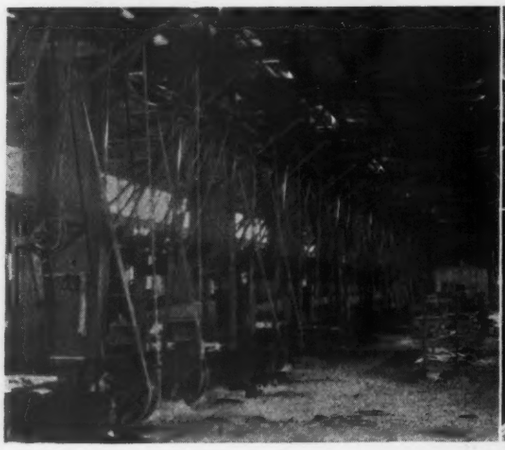
This pillow block consists of two Timken, tapered-roller bearings mounted on a steel tube or sleeve in a rugged housing. The method of fastening the steel sleeve to the shaft permits its use on any commercial shafting by setting up the screws in each of the clamping collars.

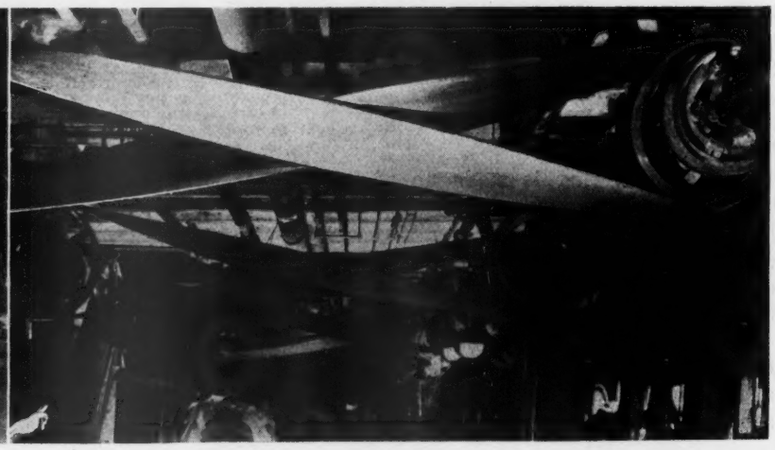
The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has developed a sealed sleeve bearing for industrial motors.

The new bearing is so constructed that the housing is practically air tight, preventing air from getting in and oil from leaking out. The bearing shell itself has not been changed in design but the housing has been altered. The cover which closes the opening through which the oil ring is admitted has been placed on the inside end of the housing instead of the outside. This location permits bolting down the cover and compressing the packing under it. For the purpose of inspecting the oil ring, a large pipe plug has been placed on the outside end of the housing. This plug can easily be removed and put back in place, air-tight. The dowel pin, which is ordinarily inserted from the out-

Two installations where the belts operate under extreme conditions.

The illustration at the left shows leather belts driving stone planers in a quarry. The loads are heavy and service conditions severe. The belts shown at the right are operating in a tannery where excessive moisture makes the operating conditions still more severe. These illustrations are used by courtesy of Chicago Belting Co.

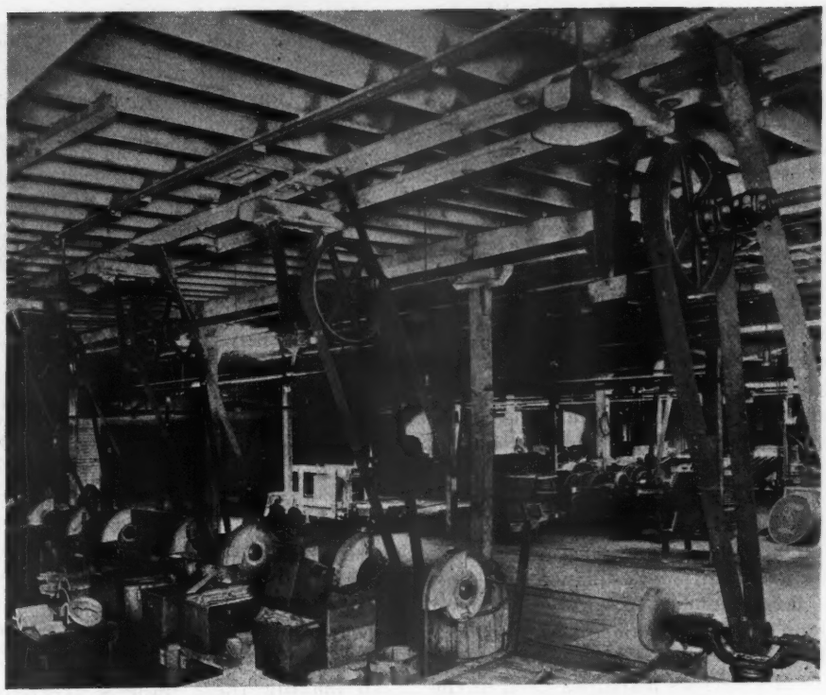




side wall of the housing to keep the bearing from turning, has been placed on the inside of the housing and any oil pumping is thus rendered harmless since it is inside the housing itself. To further guard against leakage, tapped holes have been eliminated wherever possible and the drain plug usually found at the bottom of the housing has been removed.

To eliminate throwing of oil, a conical collar forming a seal and acting as an oil thrower has been placed on the shaft on the inside of the bearing.

For the purpose of dustproofing the housing, soft felt washers are placed at either end. In very dirty places a double chamber cap can also be provided at the outside end.



This row of grinding machines is driven directly from the lineshaft through clutch pulleys made by the Conway Clutch Co.

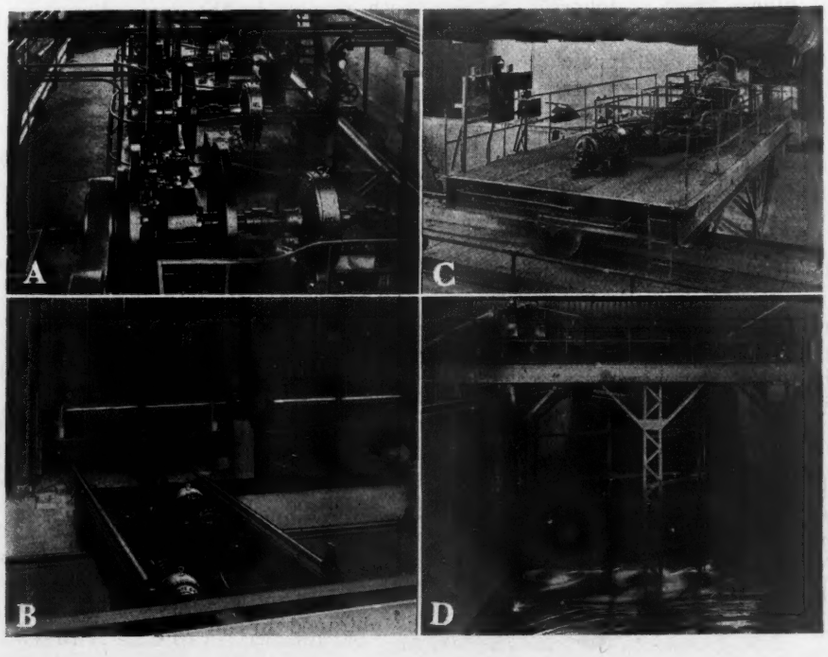
Belting and Pulleys

The Leather Belting Exchange, which is an association of leather belting manufacturers, has for some time carried on practical research work covering the problems involved in the manufacture and application of this equipment. A non-technical summary of some of this research work, which has been done under the direction of R. F. Jones, has recently been published by The Leather Belting Exchange. This report contains the results of studies made on such subjects as: arc of contact studies; effect of center distance on transmitting capacity; the effect on the belt's capacity of using a small pulley to drive a large one, and *vice versa*; and so on.

This report is well illustrated with curves and charts and contains a large amount of very valuable information, much of it in tabular form.

Alexander Brothers, Inc., Philadelphia, Pa., are marketing under the name "Tentacular," a suction belting which is made up of oak-tanned leather to the under surface of which are attached narrow, longitudinal strips of soft and spongy, chrome-tanned leather. The strips of chrome leather are held in position by hollow brass rivets. The depressions, or hemispherical pockets in the strip, having the inside of the hollow rivet as bottom, are intended to act as suckers and cause the adhesion of the belt on the pulley. The adhesion of the belt is also increased to a large extent by the spongy chrome leather, which is treated with tallow. The spacing between the strips is intended to permit any air film between the belt and pulley to be squeezed out. Shifting from fast to loose pulleys is effected as with the usual leather belting and because this belting can be run at lower tension, stretching of the belt is said to be less than usual.

The thickness of the chrome



Interesting applications of IXL reducers.

In *A* is shown a battery of rotary pumps driven through speed reducers, which are reversed, (low-speed shaft connected to the driving engine) to increase the speed of the pumps. *B*, transfer table for electric annealing furnaces. The motor and speed reducer at the back drive a small pinion which engages with a rack, the outer end of which is hinged and shown here pushed back against the door of the furnace. The rack serves to pull the loaded cars from the furnace onto the transfer table. The motor and speed reducer at the front of the table drive the latter along the track when cars are put into or removed from the furnaces. *C*, movable platform which carries revolving paddles for agitating the contents of a long slurry tank in a cement mill. The platform travels on a track along the edge of the slurry tank at a speed of 935 ft. per hr. *D*, another view of the traveling platform showing the agitating paddles which are driven by a 10-hp. motor through a speed reducer. These illustrations are used by courtesy of Foote Bros. Gear & Machine Co., Chicago, Ill.

leather strips is ⅛ in., although thicker strips may be employed. The strips are either ¾ or 1 in. wide. The dressing used is tallow, which is melted and spread over the chrome strips with a brush. This dressing is applied two or more times a year, depending on the drive; as a rule, the tallow dressing is required when the strips become dry or a slight slippage occurs.

The use of this belting is claimed to eliminate slippage, high belt tension, high pressure on bearings, and the use of belt dressings. Considerably more power is said to be transmitted for the same width of belt.

The Graton and Knight Manufacturing Co., Worcester, Mass., report that tanning and other manufacturing processes have been thoroughly standardized in its plants and that a large amount of work is being done on the standardization of the types of belting particularly adapted for the various machines used in the different industries. This work involves the installation and careful study of test belts, over a period of time, so that by a process of elimination the size and type of belt best suited to the conditions is found.

Belt maintenance and reclamation work is a subject that has for some years past attracted a good deal of attention. This has come about largely as a result of the increasing severity of the service to which belting is subjected by reason of the tendency to increase belt and line-shaft speeds, with a realization on the part of belt users that belting must be kept in the proper condition if it is to deliver the maximum service of which it is capable.

Under the trade name "Renovatol," Renovatol Company, Philadelphia, Pa., is marketing a material which may be applied to belts while they are running at full speed and under full load for the purpose of cleaning and degreasing them, and leaving them soft and pliable. It is claimed that this material will remove water and dampness from belts while they are running and make them waterproof and that, by giving them a velvety, friction surface, it permits belts to be run at a very low tension. This material is intended for use only on leather and canvas belts.

The Clipper Belt Lacer Company, Grand Rapids, Mich., has recently placed on the market a new model known as the Baby or No. 0 Clipper Belt Lacer, which embodies a number of improvements. It will lace any belt up to ⅜ in. thick and 4 in. wide in one operation. For wider belts it is merely necessary to repeat the operation. A vise is used in connection with this tool.

Clipper Rustproof Hooks have recently been brought out by the same company for use in laundries, mines and other places where there is excessive moisture and ordinary hooks show corrosion.

One feature of a new line of paper pulleys, recently placed on the market by the Best Pulley Mfg. Co., St. Louis, Mo., is the use of a patented, double-locking hub which has three sets of ribs each which grip into the paper and prevent the hub from coming loose, even though the pulley may be reversed in direction. These ribs are a part of the hub and extend out from the hub in a V-shape so that when the hub is hydraulically pressed into the pulley it becomes an integral part thereof.

In making these pulleys, treated paper is hydraulically compressed into a solid block. The end grain of the fiber is exposed to the belt so that belt slippage will be reduced.

It is stated that the pulleys are to be built in 2,500 stock sizes.

Speed Reducers

The De Laval Steam Turbine Co., Trenton, N. J., has developed a line of worm gear reductions which are applicable to motors and turbines driving such machinery as rotary kilns and coolers, tumbling barrels, agitators, mills, paper machinery, machine tools, stokers, cooling tables, transfer rolls, elevators, conveyors and so on. It is claimed that in the De Laval worm gear, three or more teeth are always in contact, giving exceptionally high load capacity for the size and weight, and making the gear suitable for heavy-duty service.

The reduction is completely enclosed in a casing, which keeps out dust and moisture. The casing is split horizontally in the plane of the center line of the wheel shaft, and the lower half is supported by four substantial feet designed to permit air circulation underneath.

The wheel shaft is carried on plain bronze bearings, so split as to be easily removable without disturbing the wheel shaft or the couplings. The side thrust of the wheel is carried by a hardened, ground and polished steel plate.

The worm may be located either above or below the wheel and is mounted on ball bearings, the one at the rear of the worm being of the double type and designed to carry the combined radial and thrust loads. The bearing at the forward end of the worm is of the radial type; the inner race is pressed on the worm shaft, while the outer race has clearance axially, permitting the bearing to adjust itself to the linear expansion of the shaft.

De Laval worm reduction gears are made for transmission ratios of approximately 4 to 1 up to 100 to 1 in one step, and for any higher ratio with double reductions. Flexible couplings of the pin and rubber bushing type are used to connect the worm shaft to the driving machine and the wheel shaft to the driven machine.

The Hill Clutch Machine & Foundry Company, Cleveland, Ohio has developed the "Industrial Type" spur gear speed transformer for all general industrial work where speed transformer units are operated under continuous or heavy service conditions. This speed transformer consists of a nest of plain spur gears revolving in oil. Both high- and low-speed shafts are supported in double bronze bearings, insuring, it is claimed, strength, rigidity and quiet operation.

A splash system of lubrication, obtained by a metal disc on the high-speed shaft, is used. The entire unit is enclosed and is claimed to be dustproof and leakproof.

Both high-and low-speed shafts are in identical axial alignment and both revolve in the same direction.

The Poole Engineering & Machine Company, Baltimore, Md., has recently brought out two new types of reduction gears known as type H and type K, respectively.

The type H reduction gear consists of a herringbone gear and a herringbone pinion cut integral with the high-speed shaft. Both gear members are said to be made of special steels and heat-treated.

The gears and pinions are totally enclosed in a cast-iron, horizontally-split casing with bearing bosses integral with the top and bottom halves of the casing. The bearings are removable and consist of cast-iron shells lined with babbitt metal. They are supported in bosses cast in the top and bottom halves of the casing.

For low-speed drives lubrication is obtained by an improved splash

and gravity system. For turbine and other high-speed drives an oil pump and cooler are provided.

The type K reduction gear consists of a herringbone, forged-steel pinion integral with the shaft and a cast-steel herringbone spur gear. The gear and pinion shafts are mounted in babbitted bearings of the ring-oiling type and are lubricated by the splash system.

A recent addition to the line of worm-gear reduction units manufactured by the Cleveland Worm & Gear Co., Cleveland, Ohio, consists of a small unit to transmit loads up to 3 hp. It is available in ratios varying from 5 to 1 to 30 to 1.

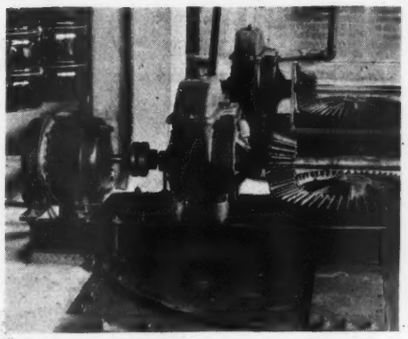
The worm is located above the wormwheel and is mounted on ball bearings of a combined radial and thrust type, designed to take a thrust load in either direction. The thrust and radial loads from the wormwheel shaft are taken by the Timken tapered-roller bearings on which this shaft is mounted.

The case is of cast iron and has sufficient volume to accommodate an ample supply of lubricating oil. The wheel bearings are lubricated by the splash from the gearing, the contacting surfaces of the worm and wormwheel as well as the worm bearings being lubricated by the oil carried up from the reservoir by the wormwheel as it revolves.

The Meachem Gear Corp., Syracuse, N. Y., has recently taken over the manufacture of a speed-reducing mechanism for the transmission of power from high-speed turbines or motors to machinery that must be driven at a lower speed.

In this reducer the load is transmitted from the high-speed shaft through planetary gears to a slower rotating ring. A number of rockers are connected inside the ring and engage a spider keyed to the low-speed shaft. As the driving motor or turbine starts up, the engagement of the rockers with the spider causes each rocker to compress a spring plunger. This action brings the bottom of the rocker into positive contact with the inside of the ring, and, at the same time, causes the side of the rocker to make contact with the side of the adjacent spider tooth.

The load on the turbine or motor is reduced to practically nothing during the time required to compress the springs, this period of time corresponding to about one-quarter of a revolution. The load is, therefore, said to be transmitted gradually and without starting shock. The spring plungers also aid in the maintenance of quiet operation, since they tend to eliminate vibration and backlash.



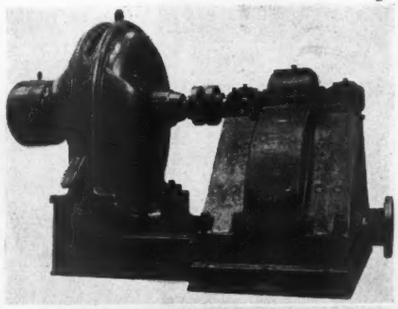
These agitators are driven by 10-hp. motors through 9.86-to-1 ratio. Industrial Type speed reducers made by The Hill Clutch Machine & Foundry Co.

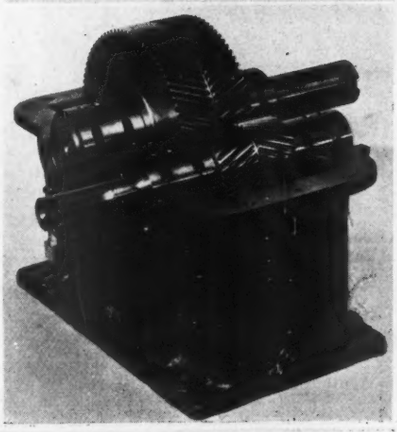
The shafts are mounted on ball bearings which are housed in substantial casings and have ample provision for lubrication.

The mechanism is entirely inclosed in a dustproof casing, and all parts run in oil, with forced lubrication above 1,800 r.p.m. The reducer can be used for either step-up or step-down speed changes. It is furnished in ratios from 4 to 1 up to 200 to 1, and for loads up to 500 hp.

Herringbone gears are used in the new speed reducer brought out by the Poole Engineering and Machine Co.

The type K reducer, in which the pinion or high-speed shaft is on top, is shown in the upper illustration. The lower view shows the type H reducer with the top casing removed.





Foote Bros. Gear and Machine Co., Chicago, Ill., report that several novel and interesting applications of IXL speed reducers have been made during the past year. For example, in an installation at the plant of the Western Machinery Mfg. Co., Sedalia, Mo., a number of these speed reducers are used to increase the speed of a battery of rotary pumps.

What is said to be another new application of IXL speed reducers is in the plant of the Glens Falls Portland Cement Co., Glens Falls, N. Y., where a change in manufacturing processes made necessary the installation of a slurry storage tank 125 ft. long, 25 ft. wide and 21 ft. deep. Owing to the size of the tank it was considered impracticable to use the standard form of stationary paddle mixers, and a traveling agitator with rotating paddles was installed.

Briefly, the agitator consists of a platform built on a structural steel frame and equipped with wheels which run on tracks on the edge of the tank or pit. It requires 7½ min. for the platform to travel from one end of the tank to the other. Power for running the agitator arms is supplied by a 10-hp., 570-r.p.m., G. E. motor operating through an IXL reducer. The platform is driven by a 5-hp., 570 r.p.m. motor through an IXL worm gear speed reducer.

W. A. Jones Foundry and Machine Company, Chicago, Ill., has brought out a line of double-thrust, worm boxes which are intended for use where conditions do not warrant the use of a fully-enclosed, worm gear drive. They are designed to support the worm shaft rigidly, take the thrust of the worm and provide lubrication for the worm and the thrust washers. The base of the boxes is finished and the ends of the bearings are faced inside and outside. Babbitt bearings are used to support the worm shaft.

Weiss Engineering Corporation, Newark, N. J., has brought out a continuous-torque, variable-speed transmission which is said to be adapted for both automotive and industrial use. This device consists essentially of a nutating power-transmitting body called the mutor, inclosed in and concentric with a metallic sphere. The nutating body or mutor is equipped with clutch ele-

A and B—Electric power tank and portable hand power tank, respectively, made by Carr Fastener Co., Cambridge, Mass., for use with the Dot high-pressure lubricating system.

C—Gooseneck welding torches made by The Bastian-Blessing Co., Chicago, Ill.

D—Open end Clipper belt cutter, made by Clipper Belt Lacer Co., Grand Rapids, Mich.

E—Dryvin Anchors for making attachments to masonry and brickwork. Made by Star Expansion Bolt Company, New York, N. Y.

F and G—Application of Dryvin Anchors for attaching eyelet bridle ring and combination of pipe or cable clamp and ring, respectively.

H—Flexible coupling, made by Terry Steam Turbine Company, Hartford, Conn.

I—Clipper Baby belt lacer, made by Clipper Belt Lacer Company, Grand Rapids, Mich.

J—Conway CMT unit expansion clutch, made by The Conway Clutch Co., Cincinnati, Ohio.

K—Clutch pilot ball bearing, made by Standard Steel and Bearings Incorporated, Plainville, Conn. This bearing is designed for both automotive and industrial use.

The illustration at the left shows one of the redesigned Francke (Smith and Serrell) couplings used in combination with a pneumatic clutch brake for rubber mills and similar drives.

At the right is shown a combination shearing coupling installed on a 1,200-hp. strip mill drive in a steel plant. In case of excessive overload the bolts between the halves of the coupling are sheared off, preventing other damage.

ments that co-operate with the inside surface of the sphere, the transmission being designed so that the relative angular axial positions of the mutor and the sphere may be varied, the mutor nutated and the rotation transmitted from it. Power is transmitted from the driving to the driven member through the mutor which, receiving its movement of nutation from the driver, acquires from it a continuous movement of rotation about its own axis and transmits it to the driven member.

It is claimed that an infinite number of speed ratios between the driving and the driven shafts may be obtained without gear-shifting or the use of a clutch. Further claims are: It is highly efficient and not subject to great wear, as all the power is transmitted through ball bearings; it is positive in its transmission of power for all speed ratios and for all loads; it maintains constant, uninterrupted action during all speed variations.

Reeves Pulley Company, Columbus, Ind., has during the past year refined and perfected its variable-speed transmission in several important respects. One of the most noteworthy of these improvements is the development of a new, steel-link V-belt, which is designed for use only with the Reeves transmission. This chain is composed of hardened steel links flexibly bound together with double, frictionless, rocking pins. Leather tips which are cemented and riveted to steel tabs are securely fastened to the belt sides at an angle conforming to the V-shaped groove of the transmission disks.

It is claimed that the new steel V-belt is practically unbreakable and that, due to its extreme flexibility, it will run even and true at all positions of the disks. Also, it is self-cleaning and requires only a small amount of oil to insure proper lubrication. This belt will be furnished on new transmissions only when specified by the customer.

Clutches and Couplings

Smith and Serrell report that the high-speed-type, Francke flexible coupling which they are marketing has recently been redesigned to give it considerably greater strength, although the outside dimensions have been kept approximately the same. Couplings of this type are now made in capacities up to 6,000 hp., at 1,800 r.p.m.

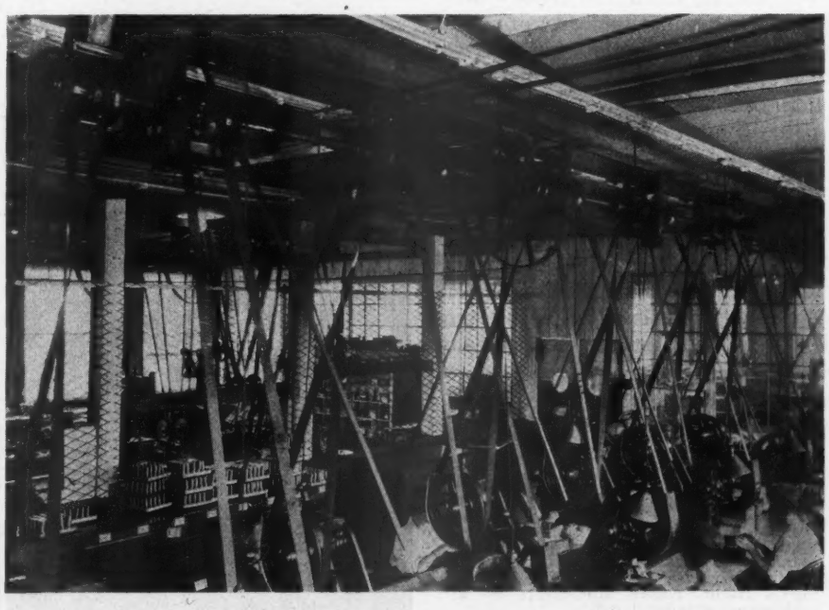
Some time ago this concern made up, on a special order from a steel mill, a combination shearing coupling having the flexible features of the Francke coupling. This coupling was installed on a 1,200-hp. drive for a strip mill and the two halves are connected by seven ⅞-in. bolts. The mill and drive is thus protected from injury when a strip doubles up or enters too cold. In one of these couplings more than 300 bolts have been broken, but more serious damage has thereby been prevented.

The Terry Steam Turbine Company, Hartford, Conn., has developed for use with all types of equipment the flexible coupling which has heretofore been used only with Terry steam turbines and reduction gears.

This coupling is of the pin-and-bushing type. One of the features to which special attention is called is that this coupling is made from steel forgings, which gives it greater

An instance where shifting of belts is eliminated by the use of friction clutches.

This shows part of a battery of 12 light bench presses which are driven directly from the lineshaft and controlled by Johnson friction clutches, in the Elmwood plant of The New Departure Manufacturing Company.



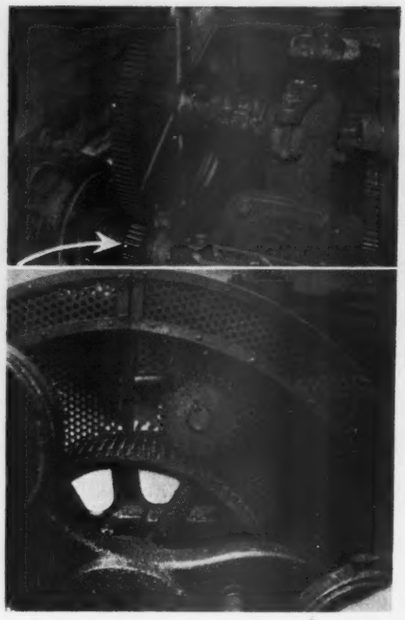
uniformity of composition and higher tensile strength. The pins are also made of steel and the cylindrical portions hardened and ground so that the bushings are free to adjust themselves under load and are prevented from transmitting any end thrust. The pins are provided with screw heads and fiber washers which, it is claimed, keep the bushings in their proper location within the driven flange.

The bushings, which are the flexible medium, are made of rubber and are ground to an exact outside diameter so that each bushing transmits its portion of the load. It is claimed that all parts of the coupling are made to limit gages and that the couplings are balanced after they have been finish-machined.

Among the advantages claimed for this coupling are: it compensates for both angular and off-center misalignment; allows free end float of connected shafts and will not transmit end thrusts; by removing the pins the shaft of either machine may be raised vertically without disturbing the other; it is easily and quickly checked for alignment.

The Conway Clutch Company, Cincinnati, Ohio, has brought out a new, type CMT, friction clutch which is claimed to be an unusually simple, self-contained friction unit, with an extensive, one-point accessible adjustment, large peripheral contact, full-length bearing for the loose member and heat-treated steel actuating parts.

On some production machines it is necessary to start and stop the machine as each piece of work is finished. This means shifting a belt from the tight to the loose pulley and back again hundreds of times a day. In such situations the use of friction clutches oftentimes presents certain desirable advantages. In this connection the Carlyle Johnson Machine Company, Manchester, Conn., reports that its friction clutches have within the past year been applied to a number of well-known production machines as standard equipment. It reports also, that there is a noticeable tendency to increase the number of friction clutches on new machines. For example, on some multiple-spindle, automatic screw machines each spindle is controlled through a friction clutch.



Celeron gears are used on these drives.

The upper illustration shows the drive for a core pump in an ice plant. The brine spray to which this drive is subjected makes the employment of iron or steel gears impracticable. Below, Celeron gears on a reel in a paper mill, where they have been in service 24 hr. a day for over four years. These gears, which are manufactured by the Diamond State Fibre Co., are made of layers of woven fabric impregnated with a synthetic resin and bonded together at a high temperature, under heavy pressure.

Miscellaneous New Developments

In addition to the equipment which has been described on the preceding pages a number of other devices of a more general nature, but which are of interest to industrial plant men, have been placed on the market during the past year. For example, the Link-Belt Co., Indianapolis, Ind., has recently added to its line of safety collars and is now marketing the "split-type."

This device is intended to maintain the proper alignment of such equipment as pulleys, shaft bearings and hangers. Its design makes installation and adjustment easier, as the collar is split in two pieces. The setscrew, by which the collar is affixed to the shaft, is flange-protected.

Michigan Lubricator Company, Detroit, Mich., has developed a valve which is being sold under the trade name of "Michigan Kant Leak Maintenance Valve." This embodies several new design features. It is claimed that a double, metal-to-metal seat insures tight closing; that the packless stem prevents any leaks and that, inasmuch as no packing, washers or gaskets are used there is nothing to swell, warp or give trouble in other ways.

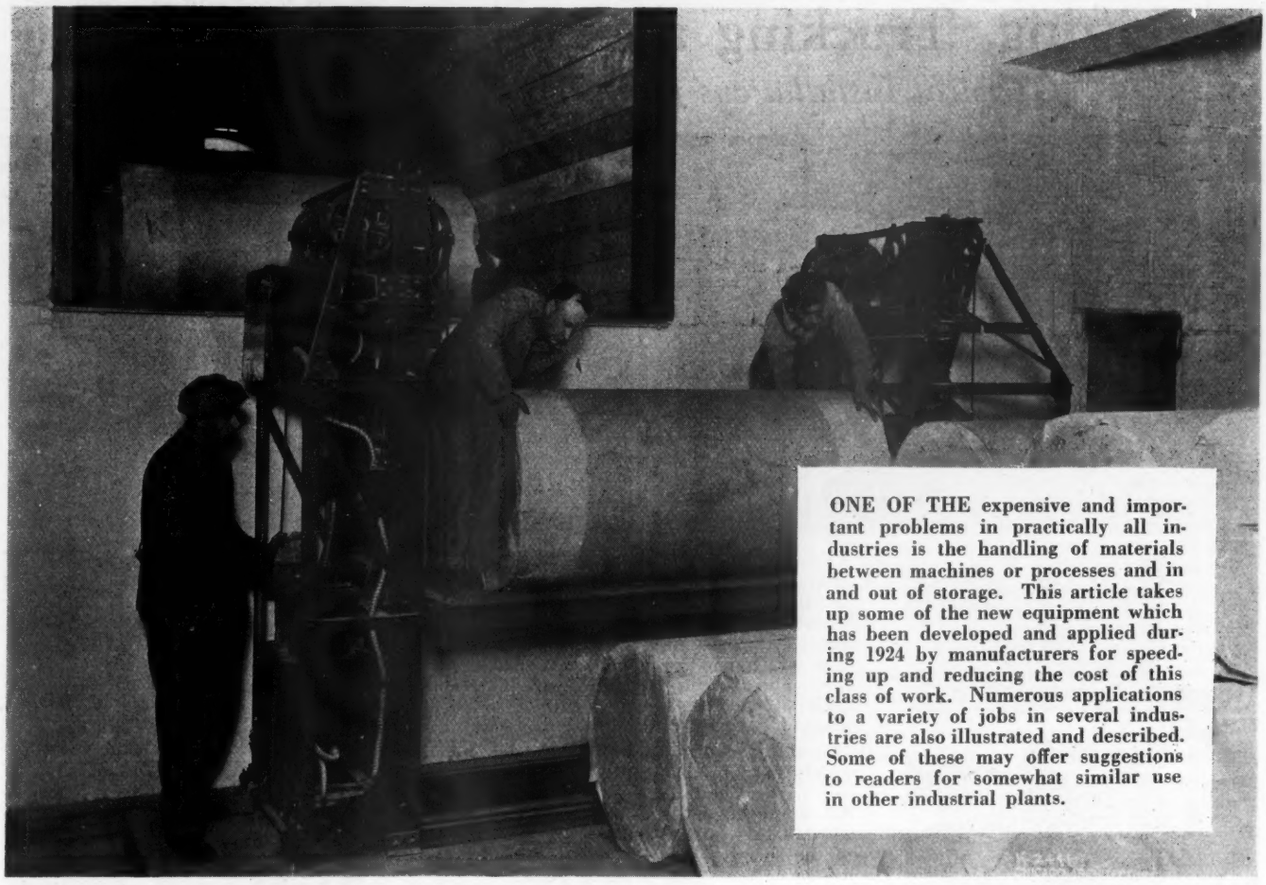
Oster Manufacturing Company, Cleveland, Ohio, has recently brought out a new electric pipe threader which will cut and thread pipe up to 2 in. in diameter. The machine is driven by a ⅓-hp. Westinghouse motor, which is furnished with a 10-ft. cord and plug that may be screwed into any light socket. The outfit is light enough to be easily portable and may be mounted on a service truck for transportation to any part of the plant.

Carr Fastener Company, Cambridge, Mass., has developed and placed on the market a new electric power tank and a portable hand-

(*Please turn to page 111*)

Knorr lubricators help to solve the problem of lubricating these machines.

The left-hand view shows two of the six Knorr lubricators, made by Malcolm H. Smith Co., Inc., on a machine in a textile mill. In this mill 376 machines are similarly equipped. Previous to the installation of these lubricators considerable trouble had been experienced with oil drip and hot bearings. Right, Knorr lubricators on a high-speed grinder head.



ONE OF THE expensive and important problems in practically all industries is the handling of materials between machines or processes and in and out of storage. This article takes up some of the new equipment which has been developed and applied during 1924 by manufacturers for speeding up and reducing the cost of this class of work. Numerous applications to a variety of jobs in several industries are also illustrated and described. Some of these may offer suggestions to readers for somewhat similar use in other industrial plants.

This double-post Economy tiering machine hoists or lowers or travels on the track under the direction of the operator at the left. Power is obtained from third rail. It is used for handling paper from the receiving chute to and from storage and then places it on the runway to the press.

Typical Jobs Where

Material Handling Devices Pay for Themselves

By Doing Easily, Quickly and at Lower Cost Back-Breaking Labor Jobs and Other Lifting, Moving and Piling Tasks Which Call for Excessive Labor Charges

By FRANK E. GOODING

Associate Editor, Industrial Engineer

NOT MANY new developments in material handling equipment were made during 1924. This was partially due to the lack of consistent demand. Also there was no shortage of labor. In addition, several manufacturers had brought out new types of equipment during the past two to four years which had rounded out their lines of equipment materially and enables them to handle with such special adaptations of their equipment as may be necessary, practically any line of work. A number of these adaptations will be described and illustrated in this article.

However, production men are taking material handling equipment more seriously and it is less difficult to convince them of its advantages over methods of doing such work by hand. Considerable effort has been directed toward making a more careful study of the material handling problem both from an equipment and a methods viewpoint. This has been particularly true in the development of special devices for holding or containing the work during handling. While much had been developed along this line previously, additional efforts have been directed toward the development of better methods of controlling the work and placing it on a more efficient basis.

Trucking is in many plants now operated on a schedule basis instead of hit or miss as has been the case quite frequently in the past. This alone has in some cases reduced the trucking force 50 per cent. In addition, much has been accomplished by a rearrangement of machines and placing them close together whereby the work does not have to be handled or trucked between machines. Because of the short distances, the work is passed from machine to machine either by hand or on conveyors. This work has, of course, been carried on for some time in the automotive plants but other industries are also taking advantage of it, with gratifying results.

Making these announcements of changes of design in various classes of equipment, does not indicate, however, that the companies mentioned

Lifting, Trucking and Piling Operations

Typical Installations from Ten Industrial Plants

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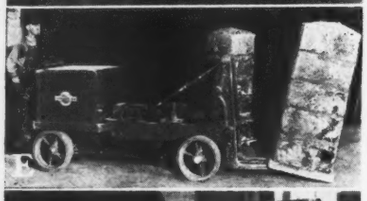
B

C

D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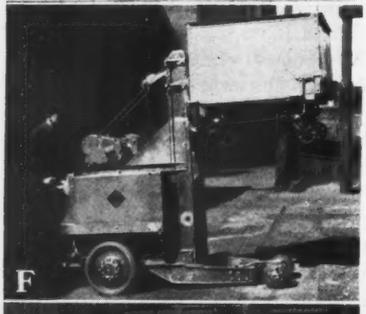
F

G

A—For many types of industrial trucking, where the distance is not great and the load not excessively heavy, hand-lift, elevating-platform trucks are becoming widely used. Here 32 cases of Orange-Crush are handled as easily as one. This Barrett lift truck will lift from an angle of 45 deg., which facilitates its use in aisles.

B—Hand-lift, elevating-platform trucks are also widely used in the printing industry for handling paper, because the paper can remain upon the platform until used without rehandling which would soil or damage a certain percentage of the sheets. This Revolvator lift truck is in use in a New York printing plant.

C and D—This special Elwell-Parker truck is used to pick up, stand on end, elevate and stack or tier heavy rolls of cloth, bales, barrels, and similar bulky objects. The load, which may be either standing up or lying down, is picked up on the apron, lifted and turned either to the vertical or horizontal and stacked 6 ft. high.

E—Several manufacturers have devised lift trucks for use in handling pots either in or out of annealing furnaces. This Crescent truck is one of three trucks in use in an Eastern foundry.

F—This Hi-Lo Elwell-Parker truck will place 2,000-lb. loads in trucks or lift the dump-bottom body high enough for the load to be dumped into bins or vats.

G—Ordinarily tiering machines or stackers are used for elevating loads which are too heavy for men to handle. In this case, a load consisting of a number of small boxes of parts is elevated so that one man can store them, whereas, previously a man on the floor and one on the bin ledge were required. The sliding platform is held centrally until the load is elevated. By means of a cable control the man on the ledge can change the height of the platform.

H—Units of material which are small can be handled effectively by grouping. Slings such as this are very effectively used for handling loads of sheets. This Baker crane truck not only lifts, but carries and piles, as well.

I—This shows how effectively lift trucks and stackers can be used in combination. The racks enable the material at Barrett-Craven's stock room to be piled five tiers high, whereas, if only the lift truck were used, more than five times this much floor storage area in square feet, would be required.

J—While the average industrial plant has use for long-boom crane trucks in some places and short-boom cranes in others, this telescoping Elwell-Parker truck gives this dual or general all-around service.

K—Here 1,800-lb. rolls of paper are piled with this Revolvator. The same equipment is used to remove the rolls from storage.

H

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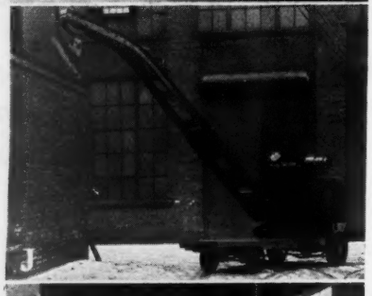
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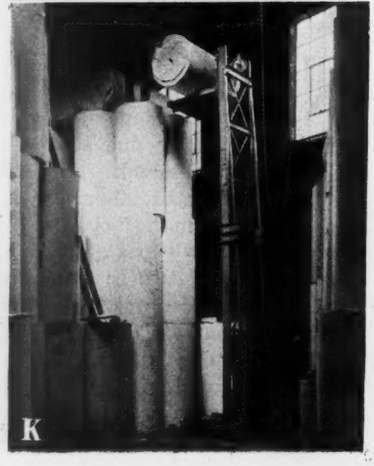
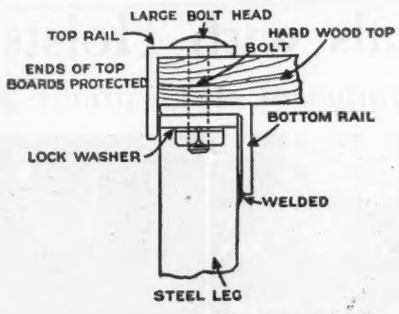

K

are the only ones producing similar equipment, as these are merely statements that the company mentioned has added the special features described. Frequently, they differ somewhat from that used by another manufacturer, although in many cases each accomplishes practically the same purpose.

Some Developments of Hand and Power Industrial Trucks

As a large portion of industrial handling is done by trucks, it is natural that much of the development during the past year has been in this field of equipment. This was also true of the previous two or three years.

About a year ago, Barrett-Cravens Co., Chicago, Ill., brought out a new type of hand-lift elevating platform truck which lifts with the handle at an angle of 45 deg. to either side so as to facilitate operation in aisles. The truck is of all-steel construction with roller bearings and Alemite oiling system. The lifting latch connects and disconnects automatically and the latch is equipped with a hardened steel roller which rolls in and out of the catch instead of sliding, thus minimizing wear.



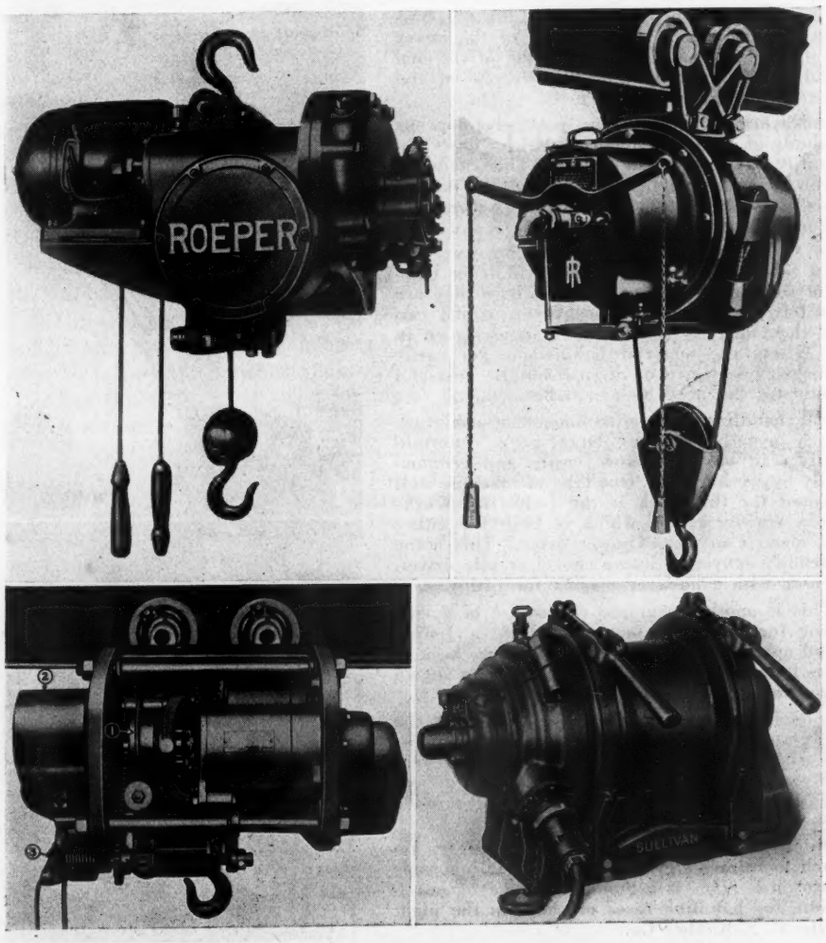
Improved construction of Barrett platform for hand-lift trucks.

In this platform for hand-lift trucks, the legs are welded to the angle-irons as shown. The other angle-irons protect the ends of the platform boards and give a firm bearing surface for the bolt heads and the legs.

One example of a special application of a hand-lift truck to the work it is to perform is shown by the special Jacklift hand truck, Lewis-Shepard Co., Boston, Mass., shown in the right-hand illustration at the bottom of page 69. This truck, which has a high lift of 6 in., is equipped with a turn-table to remove and move products that are delivered to or from a machine on rolls, such as some products of rubber and textile machines. For example, to remove a heavy roll the turn-table is placed at right-angles to the carrying platform as shown in the illustration. The uprights of the turn-table are placed under the ends of the axle running through the roll. Elevating the platform raises the roll sufficiently to lift the roll axle clear of its bearing supports. The truck is pulled out and the turn-table then revolved parallel to the carrying platform of the truck so that it can pass through narrow aisles or openings.

In some plants this type of work is done by hand hoists although many concerns have installed electric hoists for the work. Attachments like this will enable one man to remove or insert a roll alone and with the same equipment move it to its destination and similarly place it in storage or in another machine by merely reversing the process. It is to such ingenuity as this in applying special grasping or holding devices to standard material handling equipment that industrial men are now devoting much of their time and on which they depend for making increased savings. This truck could back up to a machine, lift the roll and be away before the roll could be lifted by some of the common methods of doing this work.

Manufacturers of electric industrial trucks and tractors have also brought out several new types. One of the most interesting of these, which was developed by the Elwell-Parker Electric Company, Cleveland, Ohio, is an electric elevating "Tructor" arranged for handling rolls, barrels, bales or boxes. These are handled by a revolving cradle attached to the front of the elevating platform as shown in one of the accompanying illustrations. This machine is primarily designed for pick-



Four electric and air hoists developed during 1924.

The Type R electric hoist (upper left) was brought out by Roeper Crane & Hoist Co., Reading, Pa., is available in capacities ranging from 500 to 4,000 lb. and contains an automatic stop of the trip-lever type which may be adjusted for any length of hook travel. A mechanical brake acting in series with the controller helps to stop quickly, Ingersoll-Rand Co., New York City, brought out the new type of air hoist (upper right). The outstanding characteristics are briefly: low headroom required; relatively light weight; automatic brake to hold the load if air supply fails; a graduated throttle for close regulation of lifting and lowering speeds. Some features of American Engineering Co., Philadelphia, Pa., new Lo-Hed hoist (lower left) are automatic holding and lowering brakes, a safety device to check the hoist and throw off current at upper limit of travel, roller bearings and automatic system of lubrication. The Sullivan Machinery Co., Chicago, Ill., electric hoist (lower right) can lift 2,000 lb. vertically at 110 ft. per min. The 6½-hp. specially designed d.c. or a.c. Westinghouse motor is enclosed within the hoist drum. Direct current motors are compound wound, with series characteristics.

Handling Materials with Hoists and Conveyors

Ten Examples of Equipment Applications on a Variety of Jobs

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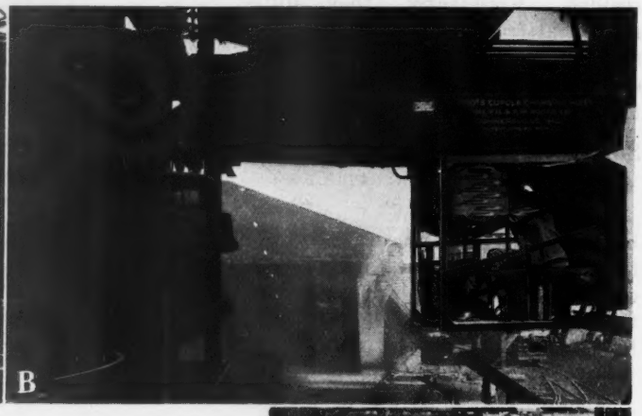
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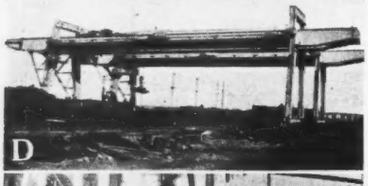
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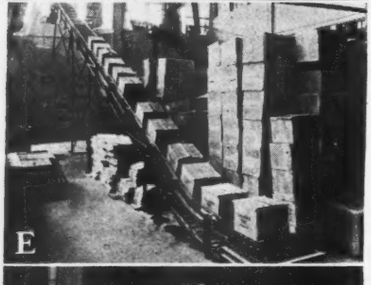
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A—Here practically every machine and assembly space is served by an Ingersoll-Rand air hoist. In heavy-machine shops, such as this, a large gang of helpers would otherwise be necessary.

B—This Root cupola-charging hoist may be operated with either magnet, dump-bottom bucket or grab bucket for handling different materials.

C—Economies have been effected in many textile plants through the use of pneumatic conveyors, such as this Sturtevant installation, for handling cotton, wool and many other light materials between operations and to and from storage.

D—These Harnischfeger Corp. cranes carry a 45-in. and a 65-in. Ohio round mill-type, lifting magnet for storing and classifying the miscellaneous scrap which is to be reclaimed or sold in the reclamation yard of the Chicago, Burlington & Quincy R. R. Because of the heavy weight and comparatively low value of the material, handling it by a magnet is one of the most economical methods.

E—Conveyors are one of the most advantageous methods of handling material which "flows" in quantity between given points. This Standard apron conveyor handles either empty or packed cases of yeast between the packing, storage and shipping departments.

F and G—Here two Jeffrey apron conveyors are used to take buckets of white lead from basement storage to the floor above where they are transferred to a portable conveyor, which carries them directly to the car door, as shown in *F*. Where the material handled is not easily damaged one conveyor often feeds the next and eliminates the need of a man between.

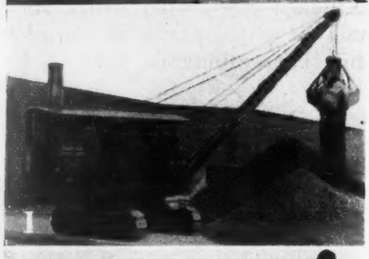
I—Coal handling and miscellaneous yard work which usually requires large gangs intermittently, can be done more easily and economically by yard cranes. One type of machine well adapted for this work is the Industrial Works 10-ton crawler crane, which is built for either gas, electric or steam power drive. This crane is readily converted into a shovel or pile driver, or used with a hook or magnet for lifting.

H—This is another example of the use of a conveyor for "flowing" material. Here a Jeffrey wood apron conveyor with cleats carries kegs of nails from the nail machines to trucks, as shown here, bound for storage or car-loading.

J—One of the problems in connection with the use of an electric lifting magnet is to care for the wire supplying power to the magnet. Here a Mogul Type Reelite (Appleton Electric Co.) is installed on a Harnischfeger Corp. locomotive crane used for miscellaneous handling.

K—Spiral chutes or other gravity conveyors do much to relieve elevators by handling materials downward. This is a Standard Conveyor installation. for handling cases of shoes in the plant of the U. S. Rubber Co.

H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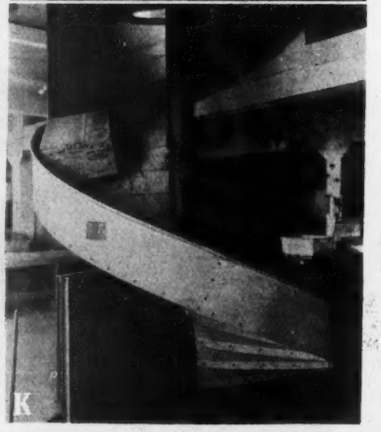
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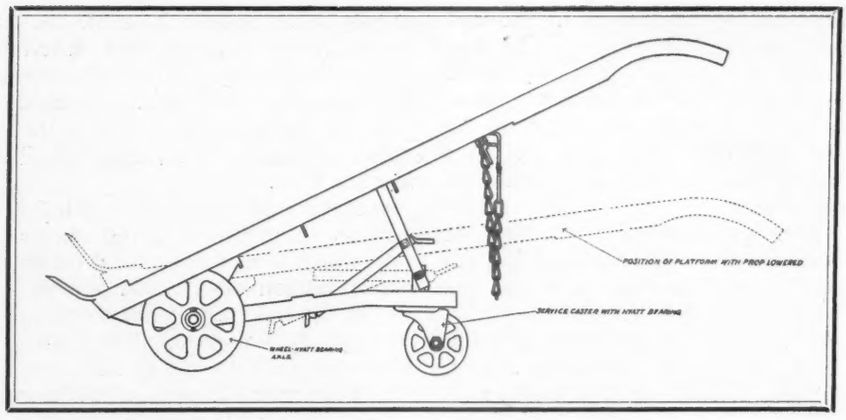


A modification of a two-wheeled truck with a swivel trailer for carrying heavy loads.

The handles of this truck are elevated vertically until the tip is worked under the load to be lifted as in the ordinary warehouse truck. When the load is lifted, however, the body of the truck can be made to recline as shown in the sketch. The operator merely pushes or pulls the load as in an ordinary truck without being required to support it nor to hold it up or lift it again in case he should let loose of it. The chain can be hooked over boxes or other packages, so as to hold them when loading the truck. This truck will handle 1,500 lb. which would be a heavy load for at least two men on the ordinary two-wheel truck.

ing this material up, whether it is lying down or standing up, standing it on end if desired and then raising it to pile up to 6 ft. high. This machine has two separate motors for operating the hoist; one raises and lowers the load and the other revolves the apron or cradle to stand the material on end or to lay it down.

Combination machines, of this and other similar types that will pick up, carry and stack are doing away with many of the back-breaking jobs in material handling. A 600- or 1,000-lb. barrel or bale can be handled and stacked by this machine and the operator easier than a man can handle a 100-lb. sack. Usually a helper speeds up the work by hooking and unhooking the chain which goes around the load. This also makes warehouse space more usable by piling several tiers high.

Another development by this company is a "Hi-Lo" tructor with an end-dump body fitted with wheels built on the platform. This will lift 2,000 lb., or from 27 to 100 cu. ft. of bulky material, transport it and elevate so that it can be dumped into a bin, car or hopper as required.

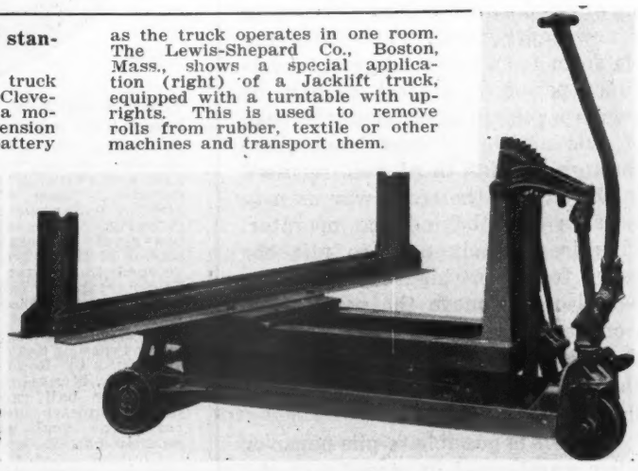
Still another development is a telescopic crane boom for attachment to the Elwell-Parker crane truck. This enables the crane to be used for high work either outside or where a ceiling is extra high as in a warehouse or railroad shop and telescope so that it can be used within cars or in buildings with low ceilings without extending the boom out so near horizontal that it cannot lift heavy loads. Improvements of this nature make equipment more of a general-duty type and help meet the varying demands put upon it in the average industrial plant.

The Baker R. & L. Co., Cleveland, Ohio, has also brought out some improvements on its locomotive type cranes on an industrial truck. This type of crane is used quite widely around railroad repair shops for holding pumps, side rods and other heavy parts while they are attached, and for high piling, serving machine tools and handling heavy material. Another interesting application was made of a Baker truck for handling annealing pots in a malleable iron foundry. Instead of using a storage battery, this truck was provided with a motor generator set connected to a standard power outlet through an extension cable. In this case, the truck was to be used only in one room. Ordinarily such industrial trucks must have a wider range of travel than is possible without storage batteries.

Another company which has done considerable development in extending their line of electric trucks during the past year is The Crescent Truck Co., Lebanon, Pa. One of these is a special elevating platform truck which has a height of 17½ in. from the floor when the platform is down and 22 in. when the platform is raised. This uses 15-in. wheels with tires 5 in. wide, which enables it to be used in yard and general purpose work. It is constructed for heavy service with a lifting capacity of 3,000 lb.

Another addition to the Crescent line is a special truck built for handling annealing pots in and out of the furnaces. Incidentally, the installation of this truck, shown at *E* page 66, and two other industrial trucks for handling loose materials enabled the company to get along with 20 less laborers than formerly had been required continuously for this work. Also, a big saving has been made in that these trucks can handle material around the plant in such quick time that men are not held for shortage of supplies, which has materially reduced the overtime formerly necessary.

In addition to their new type of lift truck, the Barrett-Cravens Co.,



Two special adaptations of standard equipment.

The annealing pot handling truck (left), Baker R. & L. Co., Cleveland, Ohio, is provided with a motor generator set and extension cord instead of a storage battery as the truck operates in one room. The Lewis-Shepard Co., Boston, Mass., shows a special application (right) of a Jacklift truck, equipped with a turntable with uprights. This is used to remove rolls from rubber, textile or other machines and transport them.

Chicago, Ill., brought out a "Steeleg" platform for lift trucks. The feature of this is that the leg is welded to an angle-iron to make the platform more rigid as shown in the sketch at the top of page 67. This strengthens the platform at its weakest point.

A new type of trailer to be used in connection with industrial tractors was brought out recently by The Service Caster & Truck Co., Albion, Mich. This consists of a platform with uprights at one end to make it a push truck, which travels on a pair of swivel casters at one end and solid casters at the other. Another development of this company is a heavy-duty caster, equipped with Hyatt bearings, and hardened steel rolls. The construction of this is shown and described in connection with the drawing below. This company also brought out a special all-steel tri-wheel truck, which is a special modification of the two-wheel hand warehouse truck, to be used for handling heavy loads. The general features of it are shown in the drawing on page 69 and the description accompanies it.

Two other new types of heavy-duty casters have also been introduced during the past year by the Bond Foundry & Machine Co., Manheim, Pa. These are both illustrated and described on this page.

Development in Tiering Machines, Stackers and Elevators

Most of the developments during the past year in tiering machines, stackers and elevators have been toward improving features of construction and also in providing special attachments or building equipment of special size and capacity to do particular tasks. For example, The Economy Engineering Co., Chicago, Ill., built a special double-post paper handling tiering machine for use in a newspaper plant. This lifts the platform from both ends and travels under power on a track as may be seen from the illustration at the head of this article. Power is obtained through special third rail recessed in the side of the track way as may be seen just behind the operator. This is not only used to pile the paper four tiers high to the ceiling but also to remove the paper from storage and put it on the runway to the pressroom, which is shown as about on a level with the operator's shoulders.

When it is possible to pile paper or other warehoused or stored material entirely to the ceiling the cubic contents count as well as floor space. Four tiers high multiplies the value of the floor space by four. Portable elevators make a cubic foot near the ceiling as valuable as a similar space near the floor.

Another type of portable double-post elevator for handling paper rolls, which is moved by hand on its wheels instead of a track, was developed by the Barrett-Cravens Co., Chicago. Other developments in this equipment brought out by this company were gear housings, a governor for controlling when lowering under load and other special features of construction.

An attachment for the Lewis-Shepard Co., Boston, Mass., stacker, is a special sliding platform built for use at the plant of the Wayne Tank and Pump Co., to be used in connection with storing material in bins, illustration *G*, page 66. Formerly one man stood on the floor, the other on the ledge and passed material from one to the other. By using a cable control, one man on the ledge can operate it to the correct height for proper unloading, or even change its height if part of the material should go in a lower bin. When the load is at the proper height a pin which locks it in the center of the platform is removed and the load rolled to one side. There is a limit, of course, as to the distance which any given weight may be shifted to the side.

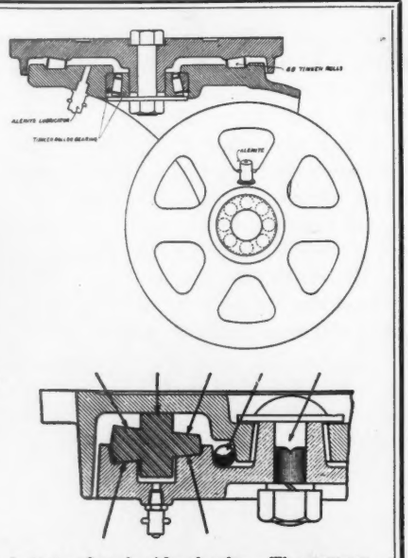
In redesigning the revolvator, manufactured by Revolvator Co., Jersey City, N. J., silent chain drive is now used. Other attachments have been over-travel limit stops, safety attachments to catch the platform should the cable break, and a new design of floor locks, together with other improvements which facilitate the operation.

The Economy Engineering Co., Chicago, has provided a special platform which may be attached to any of its various types of tiering machines so that the operator can ride up with the load. This is detachable so that it may be hooked on any of the three sides of the platform. Where it is necessary for the platform to come down close to the floor, a special folding step is used. Push button control from the platform is usually provided for machines where the operator rides with the load.

The Standard Conveyor Co., St. Paul, Minn., has also brought out several improvements in constructional features in its piling machine.

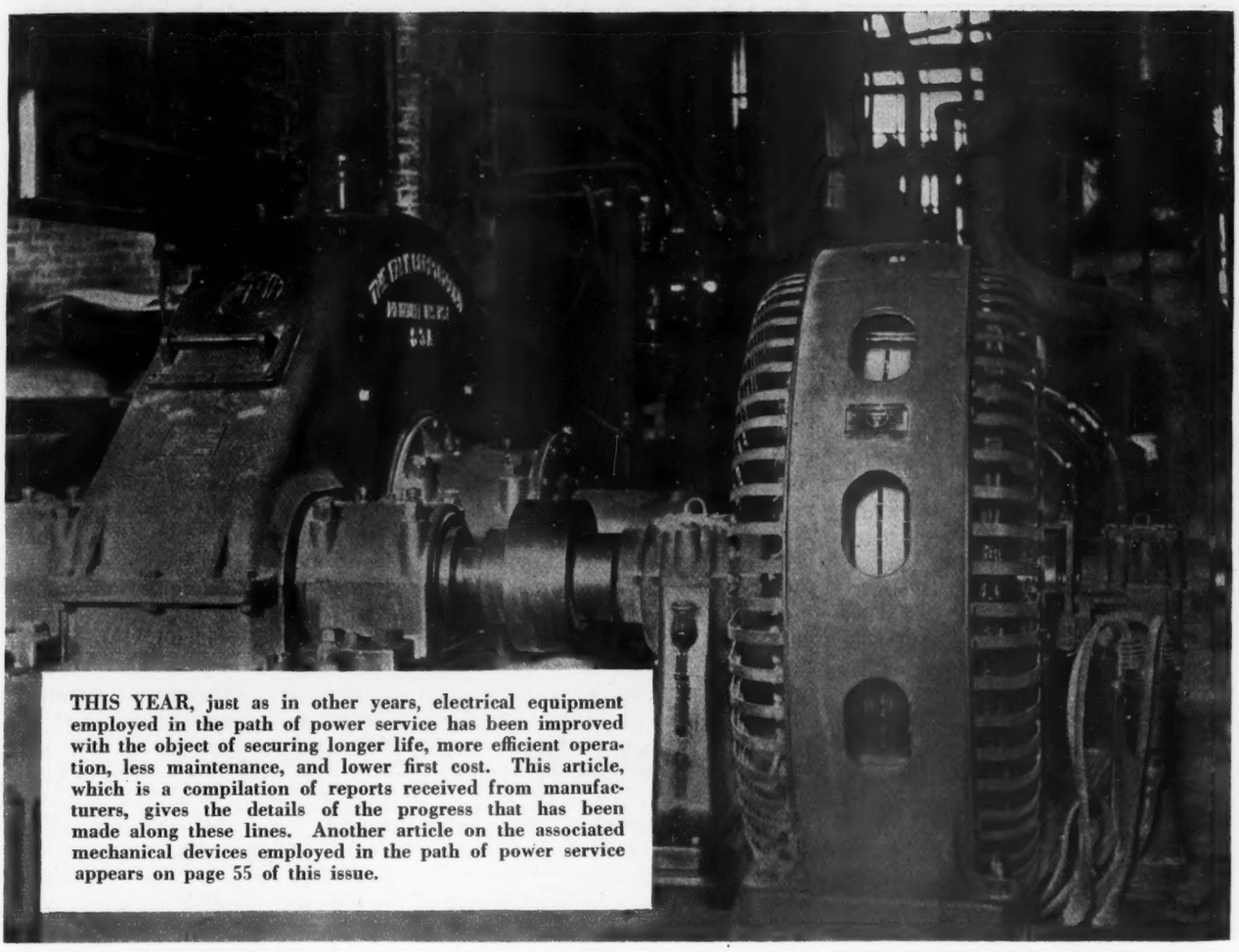
During the past year several electric and air hoists have been developed either to add sizes to already

(Please turn to page 112)



Three designs of truck casters for heavy-duty service.

Production men are realizing the value of roller or ball bearings in both the axle and swivel of the truck or trailer casters because of reduced friction and the better opportunity to lubricate properly. To meet the demand for heavy-duty operation the Service Caster & Truck Co., Albion, Mich., developed the caster with two sets of Timken tapered rolls in the swivel as shown in the drawing at the upper right. The wheel axle is provided with Hyatt bearings. In addition, two other types of heavy-duty casters were developed by Bond Foundry and Machine Co., Manheim, Pa. One of these, the triple ball race caster, has two large diameter steel balls placed to carry the load while a third, and smaller ball is located near the king bolt to absorb side shocks. The square king bolt fits into a square hole, the nut turns with the bolt and so does not work loose. The swivel is fitted with Alemite oilers. This caster is designed for unusually hard service or on loads which have been considered too large for anything but crane transportation. The other swivel caster (lower right) contains two races, one of which uses tapered rollers with shoulders and the other high-carbon steel balls. The rollers carry the weight of the load and the balls protect the king pin from shock. Any Bond standard wheels may be used.



THIS YEAR, just as in other years, electrical equipment employed in the path of power service has been improved with the object of securing longer life, more efficient operation, less maintenance, and lower first cost. This article, which is a compilation of reports received from manufacturers, gives the details of the progress that has been made along these lines. Another article on the associated mechanical devices employed in the path of power service appears on page 55 of this issue.

This synchronous motor is driving a rubber mill line. It is equipped with improved dynamic braking equipment which is said to give a reliability comparable to the direct-current drive used on calenders. No clutches or friction brakes are used on this application. Details concerning the dynamic braking equipment are given in the following article.

Typical Developments In the Use of

Electrical Devices in the Path of Power Service

That Represent the Combined Efforts of Users and Manufacturers to Improve Operation, to Reduce Maintenance, and to Modify Existing Power Drive Equipment to Meet Changing Requirements

By ARTHUR J. WHITCOMB
Associate Editor, Industrial Engineer

WHILE many of the developments in industrial equipment during the past year have been along conventional lines, there have been numerous detailed improvements that will reduce operating costs enough to make an investigation of these new products decidedly worth the time so spent. Industrial motors have been improved in ways that are expected to greatly reduce maintenance costs on them; improved motor applications have been made which have increased production; new types of control, improved resistors, new forms of limit stops and safety features have all been incorporated in control developments during the past year.

Great progress also has been made in lighting equipment that is dust-tight.

One of the first large installations of automatic equipment in a steel-plant substation has been completed. Progress has also been made in industrial heating. Who then can say that no progress has been made in industrial electrical equipment during the past year?

To help the readers of INDUSTRIAL ENGINEER keep abreast of the times, a review of the recent developments in electrical equipment has been prepared with the idea that in this improved equipment the reader may see new ways of increasing production, decreasing operating cost and insuring more reliable and satisfactory operation.

Let us now consider the developments more in detail.

Industrial Motors

General.—Development in industrial motors during the past year has taken place along the lines of bearing improvement, gas- and dust-tight enclosures, and better operating characteristics on synchronous motors.

Let us first consider the situation in regard to motor bearings. The Westinghouse Electric & Manufacturing Company reports that improvements have been made in the design and construction of bearings in oil-ring bearing motors, resulting in a reduction of oil leakage, also that a refill feature has been added to all grease cup lubricated standard motors whereby cups may be refilled without removing them.

On the other hand, that the ball and roller bearing motors have been a contribution appreciated by industry is shown by reports of Fairbanks, Morse & Company of Chicago, Ill., that 75 per cent of the motors now produced by them are equipped with ball bearings.

An increasing demand for motors with ball or roller bearings is also reported by the Howell Electric Motors Company of Howell, Mich. As a result, it added to its line a motor which is fitted with tapered-roller bearings.

The maker states that this bearing is very rugged, having lapped rolls made of molybdenum steel, which should last as long as the motor without additional adjustments after leaving the factory. However, should they wear so as to allow play in the bearings, the maker reports that they can be easily taken up by removing shims between the outer grease cap and bearing housing.

This company further states that grease retainers are used in all roller-bearing motors, so that any horizontal motor can be operated in any position, whether vertical or horizontal, as these grease retainers hold the grease in the bearing.

Special attention has been given to the interest expressed by engineers in the use of ball and roller bearings in electric motors, by The Reliance Electric & Engineering Company of Cleveland, Ohio. Both its type T direct-current motors and type AA squirrel-cage motors are now equipped when desired with either ball or roller bearings.

The Reinhard Electric Motor Company of Cleveland, Ohio, points out that it builds nothing but ball-bearing motors equipped with Hess-Bright, single-row, deep-groove ball bearings. This company also reports that it has standardized on Alemite fittings and Alemite lubricant for lubricating these bearings.

In connection with the development of ball and roller bearing design, the opportunity has been offered to improve on the construction of enclosed dust-tight motors. The Reliance Electric & Engineering Company reports that with the usual construction, it has not been possible to keep out all dust under the conditions found in coke and sintering plants and through the use of ball or roller bearings, this company has devised a dust-tight construction for the bearings. A further improvement is the use of solid end brackets for the back end and solid brackets having hand hole covers at the front end. The seats for the covers are machined. The covers are machined and fitted with rubber gaskets, thus making sure of really dust-tight joints. This construction is the same as used for water-tight motors for navy use.

The General Electric Company informs us that since it is unsafe to operate even the enclosed type of direct-current motor in the presence of vapors from gasoline, ether, and the like, a special construction has been adopted for both motors and control apparatus.

The Electro Dynamic Company of Bayonne, N. J., has developed a new ball-bearing, water- and gas-tight motor, which it states will operate with safety in places where explosive gases exist.

The Westinghouse Electric and Manufacturing Company reports that an oil-well motor having an enclosed collector has been placed in operation and has proved highly successful. A group of 20 induction motors designed for operation in an atmosphere containing one-half of one per cent of acetone have been developed by the General Electric Company. These motors are of the enclosed ventilated type, as shown in an accompanying illustration, taking air from outdoors through a pipe to the top of the motor and discharging it through holes in the side of the stator frame.

In the manufacture of its improved motors and generators, the Lincoln Electric Company of Cleveland, Ohio, reports that the operation of arc welding plays an important part. On these motors, the end frames are made by rolling a standard steel angle in the shape of a ring and welding the ends together. The feet are drop forgings and are welded to the angle steel and frame. The fan blades for the ventilation of the motor are welded to the rotor. Finally, the copper rods or winding of the rotor are welded to the short-circuiting rings.

Direct-Current Motors.—A noteworthy advance in direct-current motors has been made by the Liteweld Company of Cleveland, Ohio. This company reports that it has made improvements in the field construction—the heaviest part of any motor or generator—that reduce the amount of material required per horsepower for a given temperature rise and overload capacity to only about one-half the weight of the ordinary type of motor. This reduction in weight results in a reduction in cost, the company informs us. The company also states that these results are obtained through a divided-pole construction which enables the material in the field to be used more effectively. The ordinary induction motor of a given speed and capacity has an air-gap only 35 per cent to 40 per cent of that of the corresponding direct-current motor. In the case of the direct-current motor the air-gap has to be made longer in order to reduce the cross-flux due to the load carried by the armature. The Liteweld design is said to practically eliminate the cross-flux by forcing it to take a path of very high magnetic resistance or reluctance and this avoids the necessity of using this large air-gap, thereby permitting the use of the same sized gap in a direct-current machine as in the induction type. The manufacturer further states that since less total flux is required by this construction, the field coils can be reduced in size and, therefore, permits the radial dimension of the field system itself to be reduced.

An important development for direct-current armatures is the "Frog Leg" winding brought out by the Allis-Chalmers Manufacturing Company of Milwaukee, Wis. The maker states that the previous limitations of direct-current machines, due to the difficulties of commutating heavy loads or rapidly fluctuating loads, are now removed, and that this company is now able to offer machines having commutating qualities far beyond anything previously built.

Induction Motors.—A new company has entered the field of induc-

tion motor manufacturers. This company, The Linzee Electric Motor Co., of Mansfield, Ohio, has taken over and assumed control of the Phoenix Electric Company. For the present, the new company will continue to manufacture the old type a. c. motors and will in addition to this line put on the market a complete new line of polyphase induction motors to be known and sold under the trade name, Linzee Type L. B. and Type L. S.

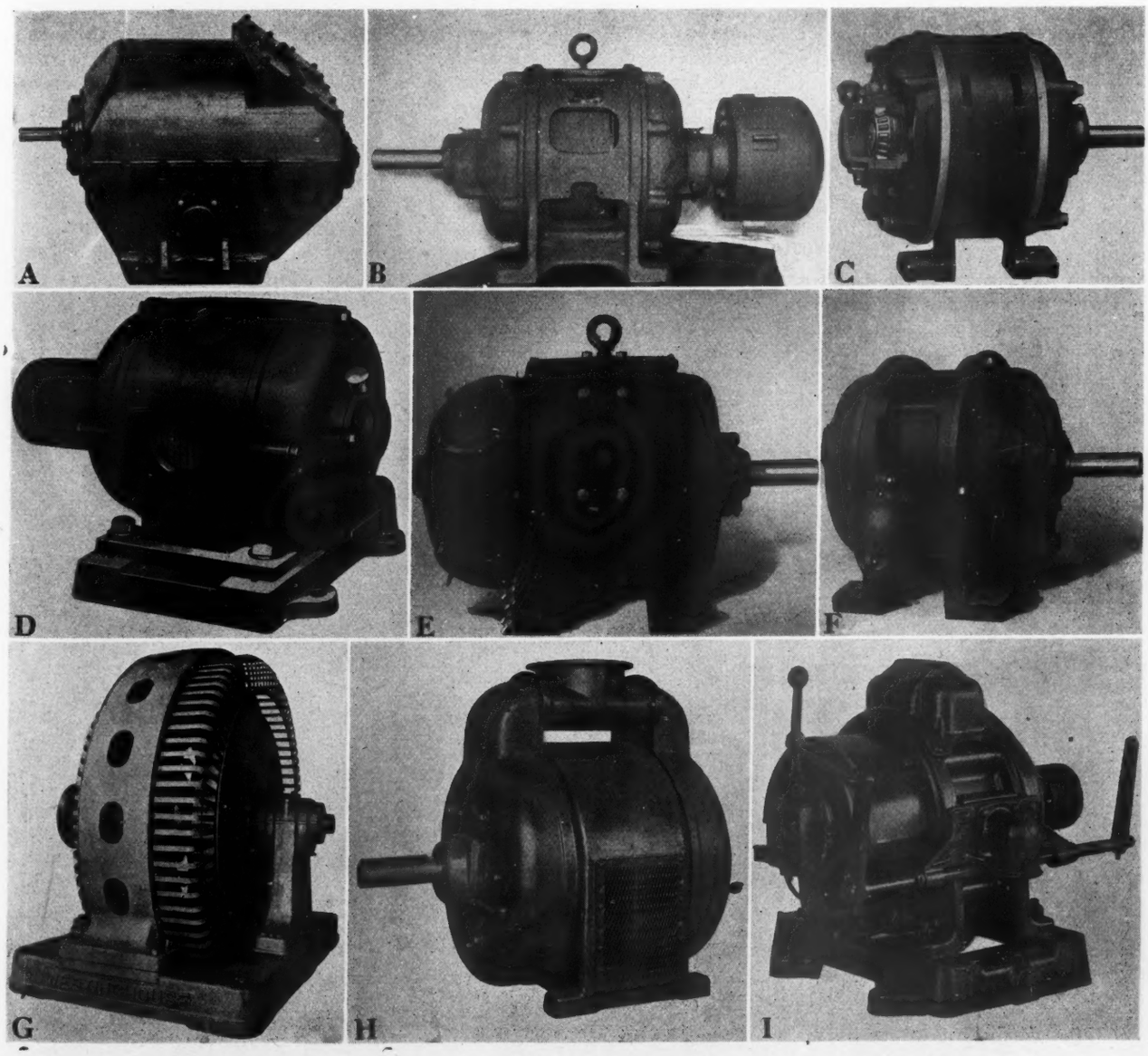
A new line of single-phase, adjustable varying speed, brush-shifting motors, having a 2½ to 1 speed range with constant torque load is announced by the General Electric Company.

Single-phase motor development also included a line of varying-speed, repulsion motors designed primarily for direct connection to slow speed exhaust fans. These motors are totally enclosed and are said to have the characteristics of a series motor which are desirable for a fan load. This development has been made by the General Electric Company.

The U. S. Electrical Manufacturing Company of Los Angeles, Cal., which has heretofore confined itself more or less to the Western market, is now shipping its motors east by way of the Panama Canal and is thus able to compete with Eastern manufacturers. This company makes a double-cage, polyphase, ball-bearing motor which is said to dispense with a compensator for starting.

New developments that have been made in motors to fit special requirements of industrial users.

These motors have been designed for the purpose of giving better protection from dust and gaseous atmospheres, for special starting conditions, to give lessened bearing maintenance, or to fit new variable-speed applications. At *A* is shown a General Electric 5-hp. gasoline fume-proof, direct-current motor which is said to cause no danger of explosion in a gasoline atmosphere. At *B* is shown a Westinghouse induction motor with the slip rings totally enclosed. This motor was designed for oil-well operation. *C* is the new tapered roller-bearing equipped motor made by the Howell Electric Motors Company, Howell, Mich. At *D* is shown the new ball-bearing equipped squirrel cage motor developed by The Linzee Electric Motor Company of Mansfield, Ohio. *E* shows the new water-tight, dust-tight, ball-bearing equipped, direct-current motor developed by the Reliance Electric & Engineering Company, Cleveland, Ohio. *F* is the type AA, alternating-current motor, made by the same company and which is now equipped with ball bearings. At *G* is shown a Westinghouse synchronous motor, having a built-in magnetic clutch so as to permit the motor to start heavy loads with a starting torque available up to the pull-out torque of the motor. *H* is a 440-volt induction motor that was designed for operation in an atmosphere of one-half of one per cent acetone. Pure air from outdoors is piped in through the top and discharged from the sides of the stator frame. This motor was made by the General Electric Company. At *I* is shown a new single-phase, adjustable varying speed, brush-shifting motor, having a 2½ to 1 speed range. It is also made by the General Electric Company.



The usual squirrel-cage motor is a low reactance machine and has either a low or high resistance rotor winding. A new line has been designed by the General Electric Company having high reactance and either a low resistance or high resistance rotor winding, depending upon the application requirements. Such motors are applied quite extensively in the smaller sizes to refrigerating machines and in the larger sizes for driving pumps and other power station auxiliaries. They are thrown directly on the line without any starter to reduce the voltage.

Synchronous Motors.—The Allis-Chalmers Manufacturing Company states that in response to the demand for small synchronous motors having a speed of 1800 r.p.m., it has developed a self-excited revolving armature type of machine. These machines are said to develop quite a high starting and pull-in torque and are well suited for centrifugal pump drive. An illustration of this motor is shown in this article.

A new line of synchronous motors for driving air and ammonia compressors that uses a new type squirrel-cage winding which permits the designing engineers to have greater control of the current and torque during the starting period of the motor, and in addition permits the motor to be thrown on at full voltage with the assurance of minimum starting current and proper torques, is reported by the General Electric Company.

A motor has been developed by the Westinghouse Electric & Manufacturing Company for use in drives where the advantageous characteristics of the synchronous motor are desirable and where high starting torque with low starting current is essential. The motor is a combination of a standard synchronous motor with a standard magnetic clutch arranged so as to form a compact unit. This permits the motor to start heavy loads with starting torque available up to the pull-out torque of the motor. The manufacturer states that the motor has the advantage of pull-out starting torque, with low starting current, combining these advantages with simple, rugged construction, high efficiency and the desirable power-factor characteristics of standard synchronous motors.

Industrial Motor Drives

Steel Mills.—The most noteworthy feature of the electrification of steel mills has been the large number of installations of new equipment that were started during a year of comparative dull times for the steel industry. This fact is a most striking indication of the economy and reliability of electric operation.

The Westinghouse Electric & Manufacturing Company report that five reversing equipments have been sold, including two large reversing blooming mills, two roughing structural mills and one finishing structural mill. This company further states that one of the greatest advances in the art was made this year when the company placed in operation a 5,000-hp., single-unit, reversing motor, which receives its power from two 2,100-kw. generators operating in parallel. It has heretofore been considered necessary to drive one motor from a single generator, and if two motors were used, two generators were required. By this new arrangement, it is said to be possible to design both motors and generators to best meet their operating conditions, rather than to have the design determined by the number of units of which the equipment is composed.

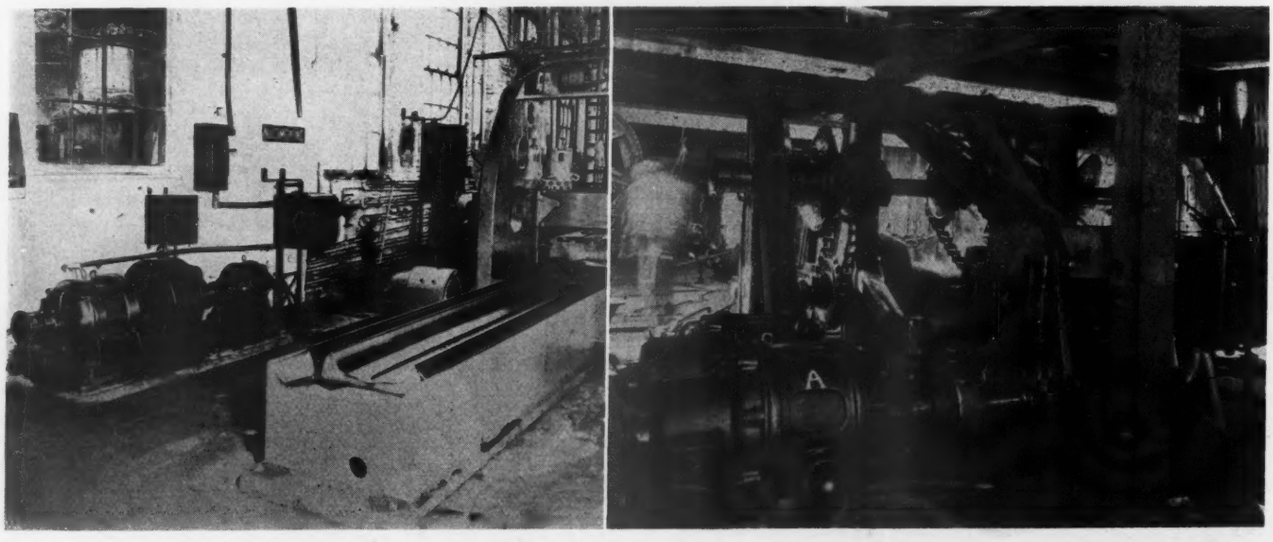
A 40-in. and a 44-in. blooming mill are each being equipped with 7,000-hp., single-unit motors by this company. These are said to be the largest single unit, direct-current motors ever built. A 500-hp., direct-current motor is being installed by this company to operate at 155 to 500 r.p.m., at any voltage from 220 to 250. This application is for a tire mill and constitutes a speed range of 3.7 to 1, which is exceptionally high for motors of this capacity.

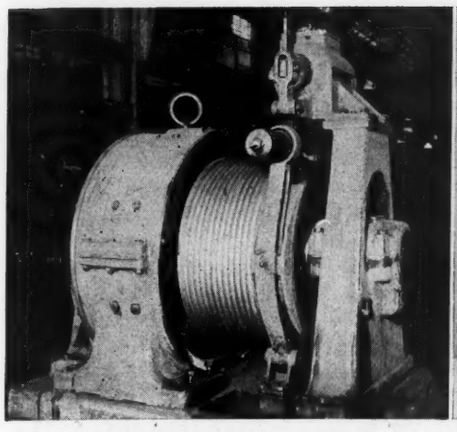
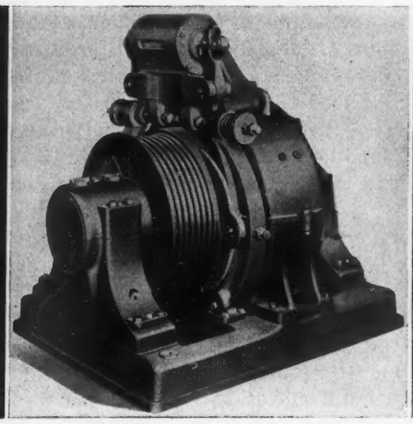
The Allis-Chalmers Manufacturing Company of Milwaukee, Wis., reports that it has installed and put in successful operation three mill-type synchronous motors on main roll drives of steel mills. The motors are coupled to the mills without the use of a clutch.

By the addition of 45,350 hp. (nor-

Two motor drive applications that are said to have greatly increased production.

At the left is shown a new variable-voltage, reversing, planer equipment that has been developed by the Westinghouse Electric & Manufacturing Co. The motor-generator set supplying the variable-voltage power can be seen at the left of the illustration. It is pointed out that this equipment gives a greater speed range, smoother acceleration and braking, combined with a power saving over the equipment previously made by this company. At the right is shown a differential drive for oil-well drilling that has been developed by the same company. Details of this drive are given in the accompanying article.



Three motor drives that were designed to fit the user's special requirements.

At the left is shown a new gearless, traction elevator motor built by the Allis-Chalmers Manufacturing Company. This is a slow-speed, shunt-wound motor, the armature shaft of which is coupled direct to the hoisting drum. In the middle illustration is shown a special, variable-speed motor application made by the Reliance Electric & Engineering Company of Cleveland, Ohio, to a wire-drawing machine. It is said that increased production is obtained with this individual drive arrangement. At the right is shown a log carriage drive developed by the Westinghouse Electric & Manufacturing Company. The motor shown is rated at 35 hp. with a speed range of 10 to 80 r.p.m. and is supplied with variable-voltage, direct-current power from a 30-kw., motor-generator set.

mal continuous rating) of main roll motors during the year, the total of General Electric main roll drives has been brought to over 700,000 hp. This company reports that an installation of particular interest is a 14-in. continuous merchant mill at the plant of the Jones & Laughlin Steel Corporation. The nine stands of this mill are driven by seven, adjustable-speed, direct-current motors. This mill will roll a very large tonnage of diversified products and the employment of individual drives with a very wide speed range is said to enable it to do the work of two or three less flexible mills.

The 26-in. rail mill at the Sparrows Point Plant of the Bethlehem Steel Company was changed over from steam to electric drive by the installation of two 3,000-hp., 500-r.p.m., 660-volt constant-speed, induction motors made by the General Electric Company.

The Reliance Electric & Engineering Company reports that one of its most important application developments is an individual wire block driven by an adjustable-speed, d.c. motor with special automatic control equipment.

Textile Mills.—An application of the brush-shifting motor to the operation of textile finishing machinery (where the operation of several motors in tandem may be required) is reported by the General Electric Company. In each case the speed of the main motor is controlled by push buttons through the operation of a pilot motor, which actuates the brush-shifting mechanism, while the speed of the other motor is controlled either mechanically or electrically by the motion of a compensating gate or floating roll between sections of the machinery.

Rubber Mills.—The Westinghouse Electric & Manufacturing Company reports that for the past two years, its mill drive using synchronous motors without clutches or brakes has proven highly satisfactory. This is said to be due to the use of dynamic braking as a means of making safety stops, which has proven thoroughly reliable and effective. During the past year, further improvements and developments in the control have been with the view of obtaining even greater reliability and quicker stopping. This company states that the development of a three-pole, double-throw, gravity-operated contactor makes it possible to use dynamic braking with either manual or automatic starters, the braking feature being entirely independent of any external control circuit or relay operation.

The elimination of the use of low-voltage and other relays in the braking circuit, together with the use of gravity operation is said to give a reliability exactly comparable to direct-current drive for calenders, which has been in use for so many years.

Lumber and Woodworking Mills.—A variable-voltage, log carriage, consisting of a d.c. motor and motor-generator set, has recently been installed on the Pacific Coast by the Westinghouse Electric & Manufacturing Co. The motor is rated at 35 hp., and has a speed range of from 10 to 80 r.p.m. Power is supplied by a 30-kw., 320-volt motor-generator set.

The General Electric Company reports that small, drawn shell type motors of unusual speed were provided for the operation of woodworking machinery. A typical application of this character consists of five small motors with operating speeds of 25,200 r.p.m., which are utilized by a single woodworking machine, the current for the small high speed motors being supplied by means of a frequency changer. The motors operate on three-phase, 240-volt, 420-cycle circuits.

Paper Mills.—A new rotary contactor regulator for sectional paper-machine drive, that is an improvement over past apparatus in that great simplicity and a more flexible action is obtained, is reported by the Westinghouse Electric & Manufacturing Company.

A paper winder drive with automatic regenerative tension control for sheets and including automatic regenerative and dynamic braking for the winder and unwinder has been placed in operation by the same company. This is said to permit much faster operation of the winder and much better control of the finished roll, as it produces a uniform tightness throughout. The expense and annoyance of frequent replacement of friction brake linings on the unwinding roll is thus avoided.

Automatic speed regulation of the vibrating regulator type for single motor paper machine drive has been developed and placed in operation by the Westinghouse Electric & Manufacturing Company. The use of this device is said to make possible a degree of regulation not previously obtainable through inherent speed regulation characteristics of the motor and generator. This is a decided advance in the art and contributes in a marked degree toward precision control, which is becoming of greater

and greater importance in this industry.

An installation of a sectional paper-machine drive, for a 175-in., 1,000-ft. per min., Kraft paper machine, has been placed in operation by this company. This is the largest Kraft paper machine built to date.

An installation of five automatic grinder, load regulators for the control of as many 1,800-hp. synchronous motors driving pulp grinders has been placed in operation by this company. The control of the load on these machines is said to relieve the governors of the power plant of an enormous amount of work and to greatly improve the frequency and voltage regulation of the entire system.

Industrial Haulage. — Induction motors designed to give a high starting torque with a relatively low current and a high efficiency when operating under load were applied for the first time to large systems of conveyors by the General Electric Company.

The first haulage electrification of an open-pit iron mine in America was effected by the adoption of three 60-ton double truck, 500-volt mine locomotives made by the General Electric Company at a mine of the M. A. Hanna Mining Company at Duluth, Minn. These locomotives are provided with auxiliary cable reels, and current supply is effected by means of an overhead trolley.

Machine Shops.—With the improvement in cutting tools and improved quality of rails has come a demand for more driving power for frog and switch planers. During the past year the Reliance Electric & Engineering Company has developed and applied motors in sizes up to 100 hp., 250-1,000 r.p.m. to such planer drives. This company further states that reversing motor drive with automatic control of such work means the elimination of belt troubles, ample power, accurate speed adjustments for a cutting speed range of 1 to 2, and a separate speed adjustment for return strokes from 50 to 100 ft. per min. Quick return strokes reduce the non-productive operating time to one-third that of belt drive.

A complete line of variable-voltage, reversing planer equipments has been developed by the Westinghouse Electric & Manufacturing Company. Each unit makes use of a separate motor-generator set; consequently, it is possible to install a variable-voltage equipment on a planer at any point in a plant having alternating-current service. Other outstanding features that this drive is said to have are a greater speed range, smoother acceleration and braking, and very simple control, combined with a power saving in service where reversals are frequent.

Elevators.—The General Electric Company reports that radical improvements were made in the operating characteristics of its high-speed elevator outfits. One of the principal difficulties in the past has been that the speed, on any one speed position of the controller, is decidedly variable with the load, being slowest when the motor is hoisting the maximum load and fastest when the motor is being overhauled by the load. The improved system consists of a motor and motor-generator controlled on the Ward Leonard principle but with the novel feature of an auxiliary series generator by which a considerable degree of compounding can be successfully applied to the main generator to an extent entirely impracticable to apply in the ordinary manner.

A new gearless traction elevator motor for passenger service has been developed by the Allis-Chalmers Manufacturing Company. It is of the shunt-wound type designed for operation at slow speeds suitable for giving normal car speeds, using standard diameter sheaves. The system of control used is the Ward-Leonard requiring separate motor-generator set and variable-voltage control.

Elevator equipment and the necessary control has been developed to such a point of perfection that speeds of 1,000 ft. per min. are now entirely possible, is reported by the Westinghouse Electric and Manufacturing Company. In fact, there seems to be no reason why speeds cannot be increased up to the limit prescribed by the speed at which humans can be transported vertically without discomfort.

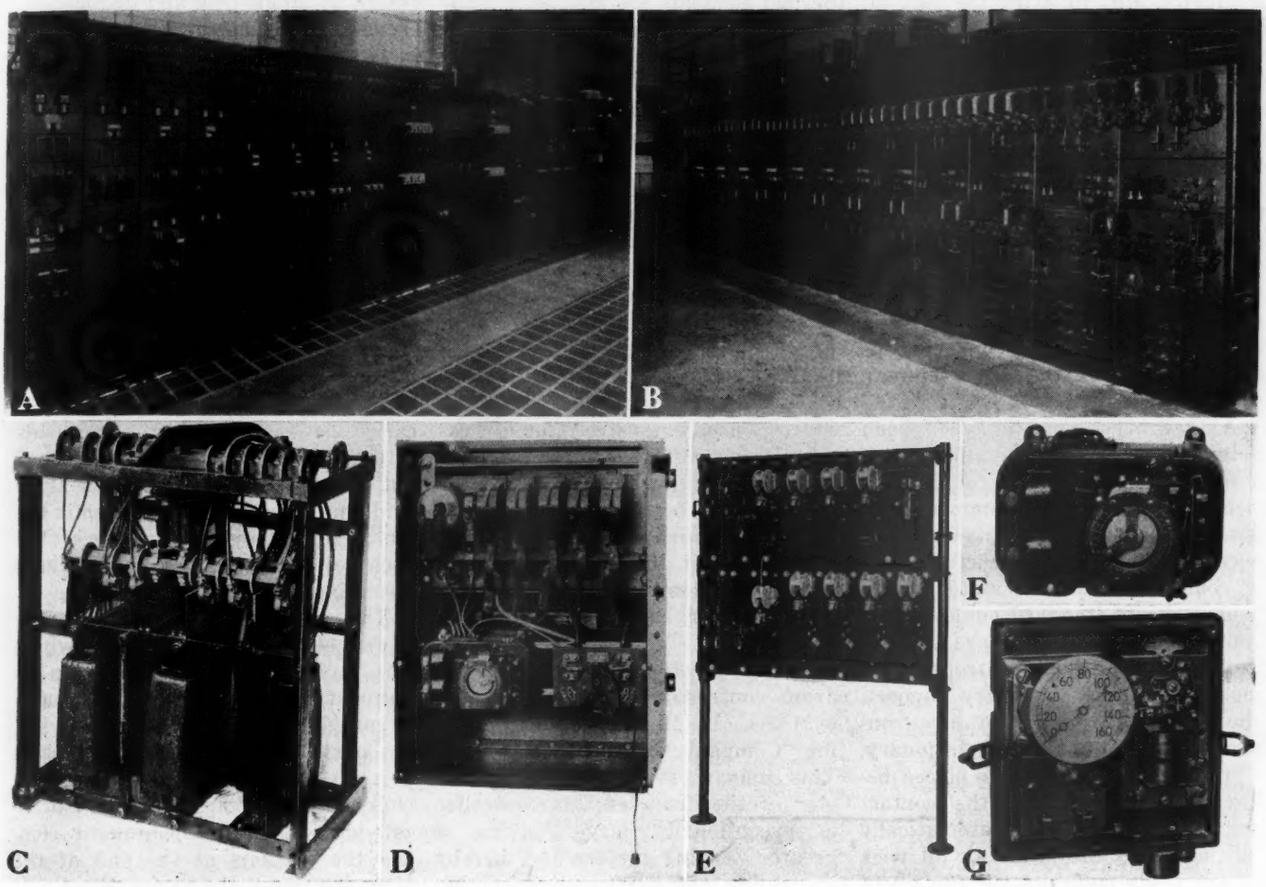
Oil Wells. — The Westinghouse Electric & Manufacturing Company reports that field tests of the Hild differential drive for oil wells have been made. Two holes, 3,700 ft. deep are said to have been completed successfully.

This drive is designed primarily for rotary drilling. Its function is the automatic regulation of the downward bit feed according to the resistance of the formation encountered. Essentially, it consists of a differential gear unit, two slip-ring motors, and a rotary drawworks. One of the motors—the drill motor—drives the rotary table which revolves the drill pipe and at the same time drives one-half of the differential. The other—the regulating motor—drives the other half of the differential. The two motors operate the differential in opposite directions, the operating motor in a direction tending to raise the drill pipe and the drilling motor in a direction tending to lower it. By adjusting the speed of the drilling motor slightly higher than that of the regulating motor, a slow downward feed of the drill pipe is produced. If the resistance to the drill is increased due to change in formation, the increased load slows down the drill motor and a slower feed results. Conversely, a lighter load means a more rapid feeding of the bit. High resistance encountered in drilling through hard rock causes the bit to rise until it clears itself.

Motor Control Equipment

Automatic Controllers. — Because of the very nature of industry and the years of study of application and performance of motor devices and control, there is always a certain amount of development and refinement in controller design and construction that is accomplished through the increased knowledge of the requirements of industrial power drives. The year 1924 has been no exception in showing progress and developments.

One of the outstanding developments is the inductive, time-limit controller devised by The Cutler-Hammer Manufacturing Company of Milwaukee, Wis. In the design of this time-limit starter the inductive principle is utilized to obtain the accelerating time, a transformer being used in place of relays, interlocks, dashpots or other moving parts to control the time of acceleration. The manufacturer states that through the medium of the transformer, a holding-out current of transient nature is obtained in successive accelerating switches. Transfer of connections takes place automatically with the cutting out of successive steps of resistance without disconnection of the coil circuits. It is said that in this new development, the ac-



celeration period is very uniform under ordinary conditions of load variations, the time being somewhat increased on heavy loads; thus the machine driven, whether reversing table, screw-down or other auxiliary machine, is always brought up to speed in the same period to insure the productive synchronism and plant efficiency desired.

Another development in time-limit acceleration is reported by the General Electric Company in the case of a 300-hp., a.c. motor on the hoist and a 75-hp., a.c. motor on the trolley of a coal tower at Clairton, Pa. Current-limit acceleration was previously used on this application and the change to time-limit acceleration was secured by using a suitable number of direct-current contactors and allowing them to close in sequence, each one being interlocked through the preceding contactor. Direct-current contactors were used to secure a slow time of closing, so that fewer contact elements were required than would have been necessary with alternating-current contactors. No time element relays were used.

Two forms of resistor-type magnetic starters for alternating-current motors have been produced by the General Electric Company; one for squirrel-cage induction motors, and one for slip-ring motors. Mechanically these starters are very much alike, their difference being chiefly in the connections. They both employ a new type of time-element relay for the accelerating period, which can be adjusted to about six seconds. The relay consists of an armature that is drawn across the face of an a.c. magnet by a spring which is distended when the line contactor closes. The magnetism resulting from the alternating current intermittently attracts and releases the armature as it slides by the pole face, thus giving the desired time adjustment.

A great advance has been made in the control of blooming mill auxiliaries, by the installation of two entirely separate control circuits, either of which can be used at will, is the report received from the Westinghouse Electric & Manufacturing Company. Each master switch is plugged into a receptacle, and in case of trouble can quickly be replaced by a spare. A complete spare control panel is included which can be quickly transferred to any motor.

Similar information comes from the Rowan Controller Company of

New controllers and new methods of installing them that are securing more flexible and convenient operation for industrial users.

At *A* is shown an installation of Allen-Bradley, automatic, resistor-type starters in the plant of the Fisher Body Corporation at Cleveland, Ohio. Twenty-six motors are controlled from a central location by means of this arrangement of control panels. In illustration *B* is shown the auxiliary control board made by the Westinghouse Electric & Manufacturing Company for the control of the auxiliaries of a 40-in. blooming mill. One of the features of this installation lies in the use of double-throw switches in the bottom sections of the boards by means of which a spare panel may be quickly transferred to any motor. At *C* is shown a new automatic compensator developed for use on potentials of 2,500 volts and less by the Electric Controller & Manufacturing Company of Cleveland, Ohio. This compensator is tightly enclosed and designed for either indoor or outdoor service. In illustration *D* is shown a new automatic compensator that has been developed by the General Electric Company for remote control of squirrel-cage motors driving lineshafting, pumps, compressors, conveyors, and the like. At *E* is shown the new inductive, time-limit, automatic controller that has been brought out by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. The outstanding feature of this controller lies in the use of an inductive relay to secure the time element required in accelerating the motor. In *F* is shown the new definite-time, accelerating relay developed by the General Electric Company. One application of this relay is shown in the compensator in illustration *D*. *G* is a pressure governor developed by the same company. It is intended for use in starting or stopping the control for air compressors or other devices requiring pressure regulation. Further details concerning the equipment illustrated at *A*, *B*, *E*, and *F* are given on pages 76, 77 and 78. More complete descriptions of the apparatus shown at *C*, *D*, and *G* are given on page 79.

Baltimore, Md., in citing the case of a switchboard containing the necessary control equipment for the auxiliaries for a large blooming mill in the Cleveland steel district. This control is shown in one of the accompanying illustrations. A unique feature of this installation is that all the controllers for the front and rear tables and the screw-down are exactly alike. An additional spare control panel is provided so that by means of throwover switches this spare can be rapidly connected in place of any of the other similar controllers.

A new type master has been developed by the Cutler-Hammer Manufacturing Company for use particularly with Cutler-Hammer magnetic-type controllers. This master is a compactly enclosed structure with a contact cylinder mounted on a square shaft. Standard non-stubbing contact fingers such as are used in Cutler-Hammer drum controllers, are mounted on the stationary support, the leads to which they are connected also remaining stationary. Pyroplax arc barriers are placed between the fingers and the contact segments which are automatically lubricated by means of an oil wick which holds sufficient oil for about six months use.

A new automatic reversing planer controller has been developed by this company. The scheme of control employed plugs the planer motor in stopping and reversing the planer, as the company reports that this results in the fastest method of operation. Two shunt-field rheostats are provided in the control—one is for regulating the cutting speed and the other is for adjusting the return stroke speed.

For several years past it has been evident that the trend of safety regulations is toward the enclosure of all types of motor starters and speed controllers. During the year, the General Electric Company reports that work along these lines was practically completed, and the remaining open-type starters and speed controllers were provided with either self-contained enclosing cases with external handle or were redesigned to accommodate enclosing cases when required.

Monitor Thermaload starters, manufactured by the Monitor Controller Company, Baltimore, Md., are now being built with standard Monitor side-arm contactors instead of the special contactor previously employed. Hairpin-shaped thermal elements are also being supplied, instead of the coiled elements previously used.

The thermal relay of the Monitor Thermaload starter operates on the thermal expansion principle. The heat produced by the thermal element under overload causes a liquid confined in a tubular receptacle to expand and to elongate two expansion units. These expansion units in turn operate an arm containing two contacts which control the operating circuit of the contactor. The liquid used is carbon tetra-chloride, a non-corrosive and non-freezing liquid which is used extensively for fire extinguishing purposes. This starter is intended for starting small induction motors, both single-phase and polyphase, and is said to protect the motor against light overloads dangerously prolonged, yet permits the motor to carry heavy overloads momentarily.

A new steel enclosed, dust-proof drum controller is being marketed by the C. H. McCullough Engineering Company of Pittsburgh, Pa. This company reports that the diameter of the drum of this controller is exceptionally large, giving a greater wearing surface and thereby increasing the arcing distance between points. This company also points out that due to its dustproof qualities the controller is especially adapted to foundries, steel works, cement plants and similar dusty locations.

The Condit Electrical Manufacturing Company informs us that during the past year it has arranged its type N-3 oil motor starters for push button control, thus making them especially adaptable to industrial service. The type N-4 starter which was developed in 1923 is now equipped with thermal cutouts.

During the past year the Allen-Bradley Company of Milwaukee, Wis., has added refinements to its lines of across-the-line starters, automatic starters, and semi-automatic starters according to reports received from this company. It also informs us that these lines have been standardized so that they can be made on a large quantity basis at a very reasonable price and yet keep the same standard of quality for which these starters have been noted.

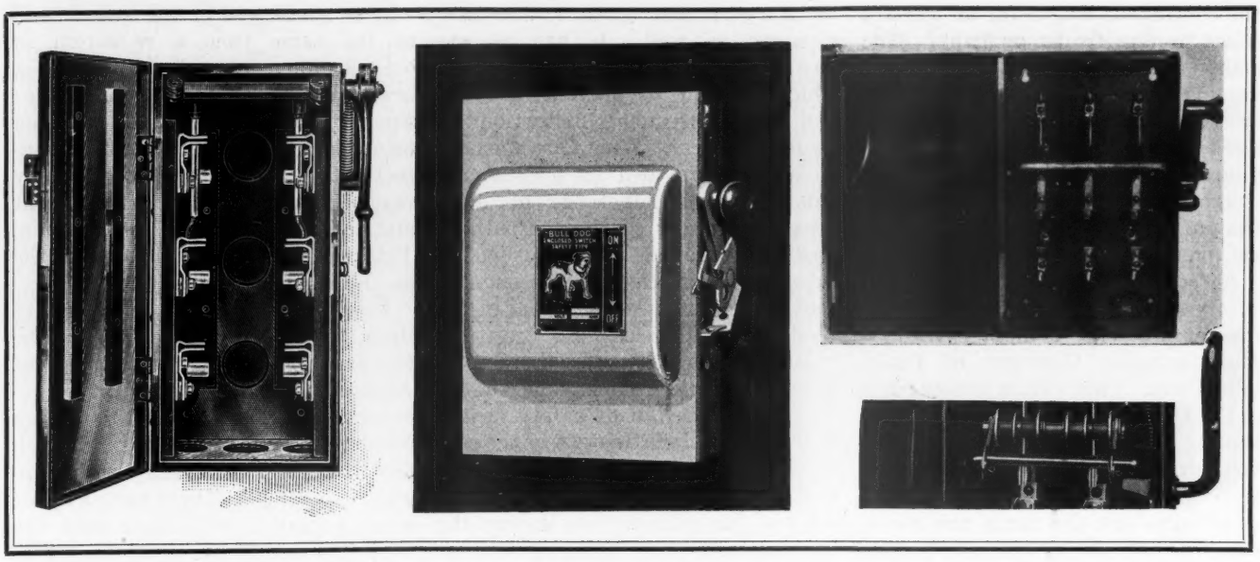
Heretofore, fractional horsepower motors have, to a very large extent, utilized standard, wiring device switches, which were primarily designed for lighting circuits. A new design of single-pole and double-pole enclosed tumbler switches, assembled in boxes for conduit wiring, for throwing small motors on the line, now gives these motors a class of control equipment comparable with that provided for large motors, is the report received from the General Electric Company.

This company also informs us that a new thermal overload relay was designed to follow the heating and cooling curve of the average induction motor, and is particularly adapted to service where it is important that the motor be permitted to carry heavy, short-time overloads intermittently, without being tripped out by the overload device. It is said that this device will permit the motor to do any kind of work that does not run the motor above a safe operating temperature.

This company states that it has developed a definite time relay which was utilized for the first time in an automatic compensator, and is used to provide the accelerating period. It consists essentially of a motor-driven train of gears, magnetic clutch, and switching mechanism to provide for either opening or closing the contacts at the end of the time for which the device is set. It is adjustable from a few seconds up to several minutes, and is adaptable to many applications where a definite time adjustment is needed.

The Cutler-Hammer Manufacturing Company states that a complete line of control equipment was brought out in 1924 for various sizes of Fynn-Weichsel, alternating-current motors (made by the Wagner Electric Corporation, St. Louis, Mo.). For the smaller sizes the face-plate type is used with the operating handle arranged for manipulating from the exterior of the enclosing case. A drum type starter is used with the larger motors and incorporates in its design non-stubbing fingers, a square steel shaft for carrying the contact segments, and blowout shields. In all of these starters the design takes care of simultaneously cutting out resistance in each of the two secondary windings found in this type of motor.

For the automatic control of motor-driven pumps, air compressors, and the like, the General Electric Company has developed a new pressure governor for use in connection with automatic starters. This governor is of the Bourdon tube type, and can be used on any liquid or gas system that will not corrode the



Less maintenance and more reliable operation are the points featured in these new safety switches. At the left is shown the new safety switch made by the Super-Safety Electric Company, Chicago, Ill. This switch is unusual in that the switch blades and jaws are mounted on the sides of the cabinet instead of on the base, thereby leaving the base clear for wiring. In the center is shown the new "Lumenized" finish, Bull Dog safety switch made by the Mutual Electric & Machine Company, Detroit, Michigan. This finish is said to resist rust, acids and alkalies. At the upper right is shown a new safety switch brought out by the Westinghouse Electric & Manufacturing Company. Special construction is said to have been used to secure durability. At the lower right is shown the new cross-bar construction developed by the Square D Company of Detroit, Mich. Improvements have been made in the insulation of the crossarm and the method of fastening it to the blades.

Bourdon tube. The equipment includes an "impulse" magnetically operated relay of a quick throwover type that breaks its own operating circuit as soon as it functions.

Three across-the-line automatic starters have been placed on the market by the Sundh Electric Company of Newark, N. J., one with undervoltage release or undervoltage protection, the second having, in addition, inverse-time-limit overload thermal relay protection and the third being provided with inverse-time-limit overload relay protection. All these starters are manufactured in either the open or inclosed type, two-pole or three-pole, for motors up to and including 10 hp., 220-440-550 volts.

This company's principal activities have heretofore been more or less confined to furnishing control for large office buildings and pump concerns. This company now plans to enter the industrial market more intensively with the present line of equipment rounded out with the additions that have just been described.

Compensators.—Two new automatic compensators have appeared on the market during the past year. One of these is a high-voltage compensator made by The Electric Controller & Manufacturing Company of Cleveland, Ohio. It is built for voltages of 2,500 and below, is push-button operated and entirely automatic. With the exception of the overload panel, which is mounted on the top of the tank, the compensator is entirely submerged in oil and the tank is so designed that the compensator is said to be dustproof, weatherproof, vaporproof and fireproof. It can be installed either indoors or outdoors.

The power supply for the push-button circuit comes from an independent low-voltage circuit which is taken from a separate transformer so that there is no danger of the operator ever coming into contact with the high-voltage circuit. The compensator is so designed that continuous torque is applied to the motor from the time the push button is pressed until the motor has been brought up to speed. This compensator is shown in an accompanying illustration.

A new automatic starting compensator, for squirrel-cage, induction motors, has been placed on the market by the General Electric Company. This motor starter is for remote control of constant-speed, two- or three-phase, squirrel-cage motors up to 600 volts for general applications driving lineshafting, pumps, compressors, blowers, conveyors, and the like. With it such equipment may be started or stopped from a distance by means of one or more small hand-operated push buttons or snap-switches located within convenient reach of the operator or automatically operated by a pressure governor, float switch, thermostat or the like.

Resistors.—A ribbon-type resistor, wound on edge, has recently been developed by the Monitor Controller Company, Baltimore, Md., and is intended for service where cast-iron grids would otherwise be employed. This resistor consists of a high-resistance alloy ribbon wound on edge in helical form and mounted on a steel-reinforced porcelain support which passes through the entire length of the unit, supporting and separating every convolution at two diametrically opposite points. This method of construction relieves the resistor ribbon from mechanical strain and permits of thorough ventilation. The maker states that the ribbon can operate at any temperature up to red heat without sagging or in any way injuring the resistor as a whole.

A system of terminals and taps enables a unit to be connected into a circuit, and to be interconnected with other units. Two simple forms of clamps provide all these facilities. These clamps may be placed at any desired point along the resistor and may be changed at will. This permits of accurate adjustment of the resistance steps. The maker reports that a saving of weight and space is obtained by the use of these resistors as compared to cast-iron resistors. These resistors are shown in an accompanying illustration.

The "EMB" grid resistor, which is manufactured abroad, is being introduced by the C. H. McCullough Engineering Company of Pittsburgh, Pa. This resistance is made of drawn material and is made in

one continuous length for an amount equal to one frame or bank. The maker informs us that this resistance is unbreakable, rustless, scaleless, of uniform section, jointless in the frame and is covered by a 5-yr. guarantee. He also states that the weight of this resistance is less than that of cast-iron grids of the same rating.

Safety Switches.—A new small safety switch has been placed on the market by The Trumbull Electric Manufacturing Company of Plainville, Conn. This switch is now made in the 100-amp., 250-volt size and will shortly be made in the 440- and 550-volt size. The maker reports that the switch is characterized by its small size, yet the parts are accessible because the switch may be easily removed from the box. The switch is constructed on the double break principle, the blades being carried on a rotor made of molded material.

A new line of quick make, quick break enclosed safety switches has recently been put on the market by the Westinghouse Electric & Manufacturing Company. This line was designed to meet the demand for a simplified, enclosed switch without the full safety features.

This switch, known as the WK-60 switch, is unique in that the quick operating mechanism has been condensed to a few simplified parts and located inside the operating handle. The maker states that this feature alone is a marked advance in the design of safety switches, since this construction will lend greater reliability, lessen maintenance cost, and at the same time, make it easier for plant operating men to inspect, test and make repairs.

A new "Lumenized" finish has been added to the line of Bull Dog safety switches made by the Mutual Electric & Machine Company of Detroit, Mich. The company states that this finish involves the depositing of aluminum flakes, like minute fish scales, upon the basic metal under high temperature. It is said that this results in giving the switch the following qualities: luminous in the dark; resists rust, acids, and alkalies: easily grounded; and is the last word in cleanliness.

A new type of cross-bar construction has been incorporated in the safety switches made by the Square D Company of Detroit, Mich. A steel bar is heavily insulated with molded composition tubes, which not only possess superior mechanical strength but greater dielectric strength as well. It has an extremely low absorption of moisture, which is said to prevent warping and the consequent distortion of blade alignment. Wide fibre washers have been provided to prevent accumulation or adherence of dust, breaking up any continuous path of dust to ground. The insulating tubes have an offset at the ends so that dust cannot work in under the washers, causing leakage.

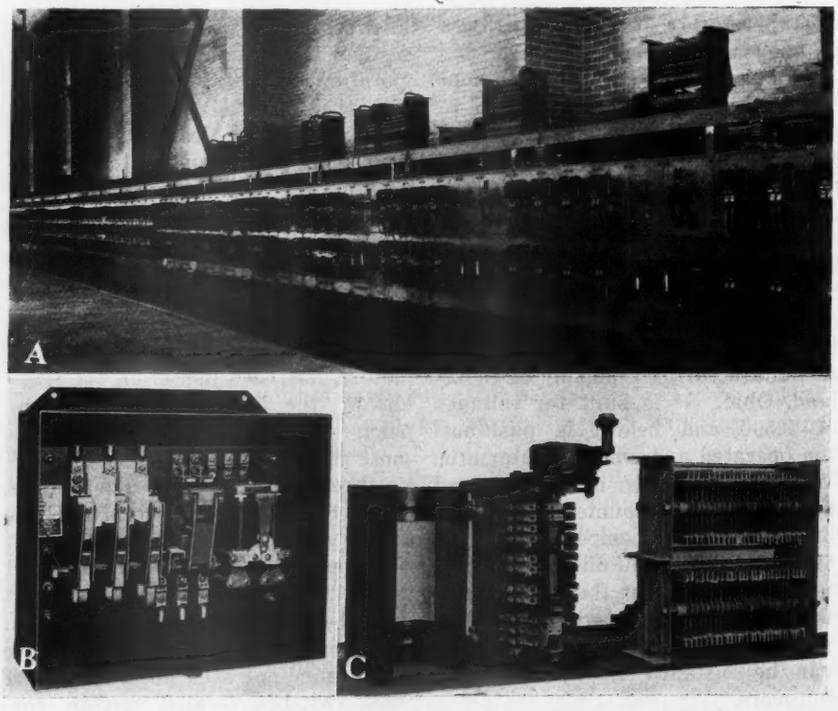
During the past year the Super-Safety Electric Company has developed a new design of safety switch in the larger sizes. Instead of the contacts being on the base of the cabinet as is usual, they are placed on sides of the cabinet, thus leaving the base entirely clear. This constitutes the principal difference between this switch and the more usual types of safety switches.

The maker reports that this type of construction results in the following advantages: greatly increased wiring space within the switch and at the same time a reduction in overall dimensions; double break—a break on each side of the fuse; greater flashover distance between polarities; and perfect and even contact between all contact members by reason of their tandem arrangement and their self-aligning construction. This switch is shown in one of the accompanying illustrations.

Limit Switches.—A new safety limit stop has been developed by The Morgan Engineering Company of Alliance, Ohio. As shown in an accompanying illustration this device consists of a cast-iron box in which are mounted two double-throw, single-pole switches. These two switches when actuated by contact with the hook block cause the limit switch to function. The maker states that this limit switch differs from others in that a resistance is thrown in series with the armature as the limit switch starts to function, thereby slowing down the armature and greatly reducing the amount of current broken by the contactors. Complete stopping of the hoist motor is accomplished by the usual arrangement of dynamic braking. The maker points out that another feature of this limit switch is that the lowering circuits are established immediately upon the reversal of the controller, through the action of a solenoid; there is no waiting to lower through resistance. Other features pointed out by the manufacturer are: no external banks of resistance, for the limit switch is

How to insure continuous operation is a problem before every electrical superintendent.

At *A* this problem has been solved by providing a spare controller that may be quickly connected in place of an inoperative panel by means of throw-over switches. These controllers were built by the Rowan Controller Company of Baltimore, Md., and are installed in a blooming mill for the control of the auxiliary motors. At *B* is shown the new Thermaload starter made by the Monitor Controller Company of Baltimore, Md. This controller is equipped with a new thermal overload relay. *C* is a new drum-type starter developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., for the control of the Fynn-Weichsel motor made by the Wagner Electric Corp.



self-contained; positive in action, for an upward movement of the weight of even a fraction of an inch will actuate the limit stop; the switch is foolproof, having only one adjustment; extra large copper to carbon contactors are used; only one swinging weight is used, this being guided by one of the hoisting ropes; and the sequence of operation of the contactors is obtained by a single system of levers, no cams, springs or counterweights being used.

The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., reports a new development in safety limit stops which is said to be a compact, rugged unit with a number of features which are so important in the functioning of a safety device. The working parts are liberally designed and arranged to move freely; this ease of operation being still further insured by the provision of ball bearings.

Miscellaneous.—A new quick-acting, electric solenoid brake has been developed by the Whiting Corporation of Harvey, Ill. This brake was especially designed for crane service application.

The maker points out that the brake arms are so pivoted that the shoes release equally at all points; there is no chance, therefore, of the shoes dragging at the lower ends. This is said to be a big advantage in applying the brake as the shoes bear equally at all points, resulting in quick braking action and uniform wear.

Improvements in its electro magnetic sander are reported by Nichols-Lintern Company of Cleveland, Ohio. An electrically-heated chamber has been placed around the sand box, thus keeping the sand warm and dry, thereby greatly increasing the efficiency of the sander. These sanders are intended to replace dangerous and wasteful hand sanding methods and are said to save crane and runway maintenance.

The use of static condensers for power-factor correction in industrial plants has increased considerably. The Westinghouse Electric & Manufacturing Company reports that it has developed a new low-voltage unit that may be connected at the motor or place where the power is used, thereby reducing the line losses in the feeder circuits. This new line of low-voltage condensers is made for 220-, 440-, and 550-volt, 60-cycle service. This condenser is shown in one of the accompanying illustrations.

The National Electric Condenser Company of New Haven, Conn., is also putting out a line of low-voltage condensers for connection direct at the motor terminals.

Control devices designed to give safer and more reliable operation of motors.

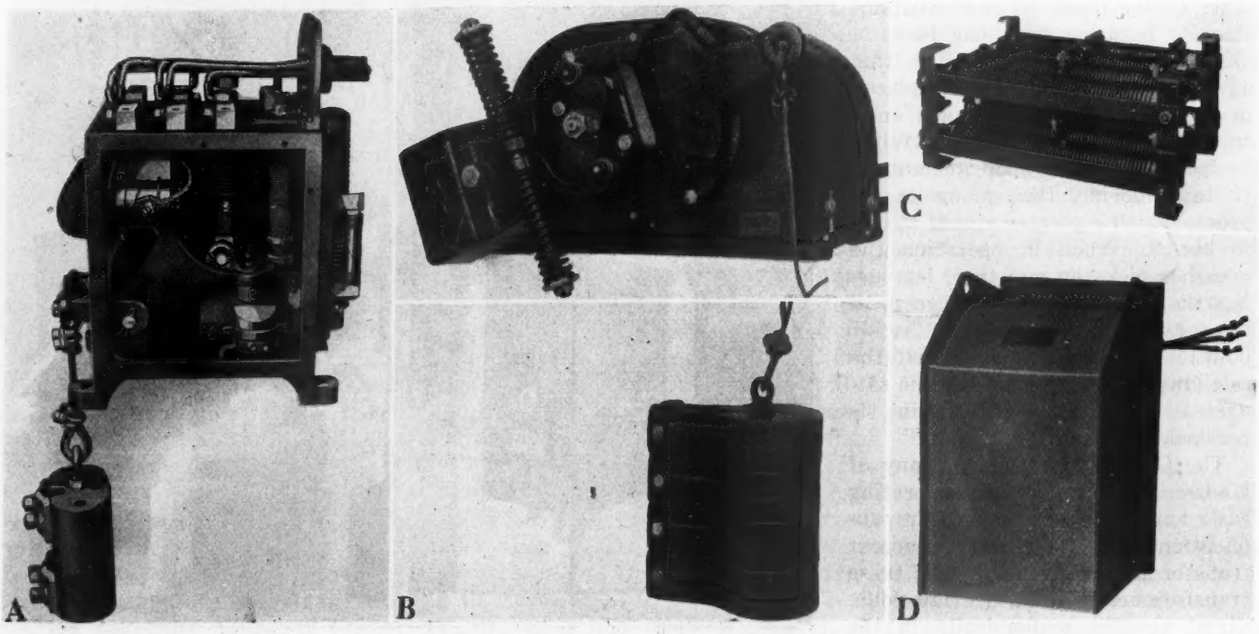
At *A* is shown the new, crane hoist, limit stop developed by the Morgan Engineering Company of Alliance, Ohio. It is pointed out that very little arcing results at its contacts during operation. *B* is a new limit stop developed by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. At *C* is shown a new resistor made by the Monitor Controller Company, Baltimore, Md. It is said to be unbreakable, very compact and light in weight, although designed for heavy-current service. *D* is a static condenser designed for connection directly at the terminals of the motor, so as to correct the motor power factor at the motor instead of in the substation and thus lighten the load on the feeder cables.

Industrial Substation Equipment

Automatic Substations.—The automatic station has become firmly established as an economic and operating necessity in the electrical industry. With its inherent advantages established beyond dispute a marked advance in the application of this type of control was made during 1924.

There were no radical changes in the design of automatic switching equipments. The tendency during 1924 was to produce unit equipments which are easily handled and installed and to standardize wherever possible. The General Electric Company reports that standardization has progressed to such an extent that complete automatic stations for mining and industrial service are now being stocked.

To meet the requirements for this class of service, the General Electric Company states that one type of standardized design is so arranged that a single machine, automatic control equipment may be used in either a single- or multiple-unit station with any number of reclosing feeders, thus giving maximum flexibility since it allows the arrangement of converting units in any desired manner with a possibility of later re-arrangement if called for by a change in load conditions. This may then be accomplished without modifications of the control.



Transformers.—The General Electric Company states that many detailed improvements have been made affecting both the construction and operation of transformers of various types. One of these consists of a scheme for bringing underground cables into the transformer without any exposed terminals or live parts. The underground cable is brought up into a compartment filled with fluid insulating compound. Suitable links and connectors are provided in this compartment so that the cable may be properly phased in. This compartment is connected by means of bushings, to an upper compartment which is kept filled with oil by means of a pipe leading to the main tank.

The Packard Electric Company of Warren, Ohio, reports that the designing of a complete new line of steel cases for distribution transformers has been completed. The use of cast-iron cases by this company has been discontinued, and all shipments are being made in the new cases.

The Westinghouse Electric & Manufacturing Company reports that during the past year, a transformer has been built mounted in a rectangular tank, so arranged that one side of the tank could be removed and the transformer rolled out on a track for inspection and repairs. This was necessary on account of the limited head room, preventing removal of the windings through the cover of the tank.

This company has also developed a new and improved type of breather designed to overcome the disadvantages of the usual form of calcium-chloride breather that has been in use for so many years. With this device, the calcium-chloride is placed in a screen basket suspended on a spring of large diameter. When loaded with the proper amount of calcium-chloride, the spring is depressed until a pointer stands at "fill to here." When in operation the breather picks up moisture, increasing the weight of the charge until the spring is depressed to the "refill" point. The design is such that the calcium-chloride will not become saturated before the refill point is reached.

The Gisholt Machine Company of Madison, Wis., reports that operating costs have been reduced in many applications of their direct-current transformers. The purpose of these transformers is to reduce 110 volts, direct current economically to the lower voltages required by master clocks, time stamps, cost recorders, signal bells, buzzers, annunciators, alarm systems, elevator bells and the like.

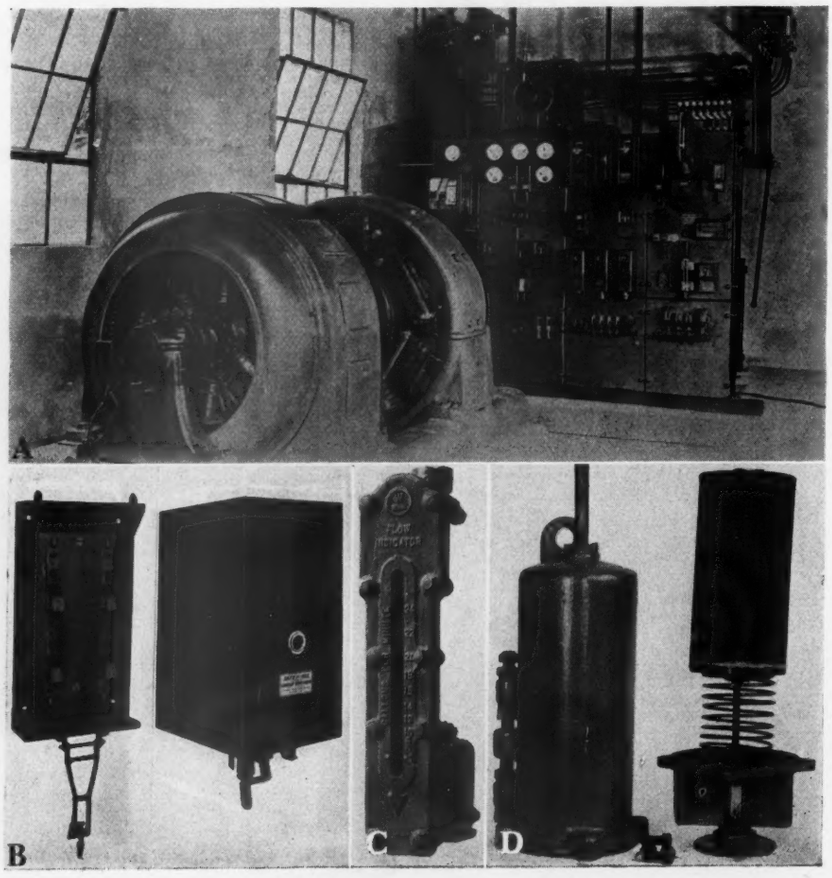
An improved design of flow indicator for use with water-cooled transformers has been brought out by the Westinghouse Electric & Manufacturing Company. The instrument may be used on either an open or closed water system, and operates without the use of moving mechanical parts. An indicator is used in each section of the cooling coils where more than one section is used, thus giving an opportunity to regulate and equalize the amount of water in each section.

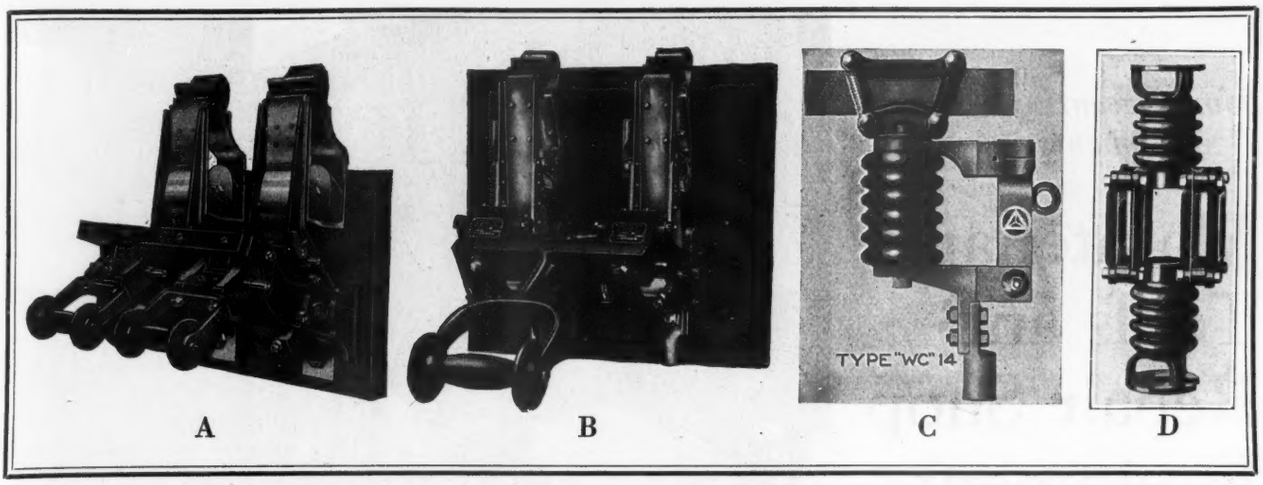
Carbon Circuit Breakers.—Several new developments have appeared in carbon circuit breakers during the past year. A shock-proof circuit breaker has been developed by the Roller-Smith Company of New York. N. Y., and is recommended by them for installations where there are apt to be conditions of excessive mechanical vibration. A new double-pole, interlocked-trip circuit breaker has also been developed by this company and its outstanding characteristic is said to be in the fact that the two poles are closed independently and successively; the pole first closed will open as soon as the second pole is closed if an overload exists and both poles will open simultaneously on an overload. This type of breaker is intended for use on motor and feeder circuits in place of switches and fuses.

The enclosed line of circuit breakers made by the Cutter Company, Philadelphia, and sold under the trade name of "U-Re-Lite" has been expanded by the development of three new and larger "U-Re-Lites" which will handle currents up to 400 amp. at 250 volts, 200 amp. at 440-550

The savings that automatic substations can make are being increasingly appreciated by industrial plants.

At *A* is shown the automatic switching equipment controlling a synchronous motor-generator set. This equipment was made by the General Electric Company and is installed at the mines of the Heisley Coal Company, Nanty-Glo, Pa. *B* is the "Safe-for-All" circuit breaker made by the Automatic Reclosing Circuit Breaker Company, Columbus, Ohio. The wiring is connected to the terminal board at the left; the circuit breaker mechanism and cover can then be quickly removed and replaced with a spare should the occasion arise. At *C* is shown the latest type of flow indicator made by the Westinghouse Electric & Manufacturing Company for use with water-cooled transformers. *D* is an improved type of dehydrating breather made by the same company for use on transformers. It has an indicator that tells when the calcium-chloride charge has become saturated and requires renewal.





Improvements in substation equipment designed to give more convenient and reliable operation.

At *A* is shown a new interlocked trip, circuit breaker made by the Roller-Smith Company, New York, N. Y., which is designed so that with one pole of the breaker closed, this pole will open immediately if the other is closed on an overload. *B* is a shock-proof circuit breaker developed by the same company for use in locations subjected to excessive vibration. *C* is a bus-type disconnecting switch brought out by the Delta-Star Electric Company of Chicago, Ill., for use in installations that are congested. *D* is a new bus support developed by the same company for supporting bars of high ampere-capacity.

volts, alternating current and 1,250 amp. at 250 volts, direct current. These new "U-Re-Lites" are larger in size and heavier in construction than the smaller types and are built with heavier parts and more liberal spacing to withstand the severe duty for which they are intended. Like the smaller types, they are said to be constructed in a manner such as to make it impossible to close them effectively against an abnormal circuit condition, and at the same time to furnish complete protection to the operator.

An enclosed-type circuit breaker known as "Safe-for-All" has been developed in sizes up to 200 amp. by The Automatic Reclosing Circuit Breaker Company of Columbus, Ohio. The purpose of this breaker is to provide individual motor protection in steel mills and industrial plants generally, in a form that is safe not only for the operator but also for the maintenance or repair man.

The manufacturer states that the outstanding feature of this circuit breaker is that the operating mechanism together with contacts, relays and so forth may be removed and replaced with a new unit in ten seconds.

As can be seen in one of the accompanying illustrations the device consists of three parts: a terminal board to which the wiring is connected, a circuit breaker panel, and an enclosing cover. The circuit breaker panel is hung over the terminal board from two lugs on the back. The circuit breaker cannot be closed until the enclosing cover is hung over it and latched in place by a lever located at the bottom of the cover.

This connects the circuit breaker panel to the terminal board and releases the operating handle so that the circuit breaker may be closed. The ease with which the circuit breaker panel may be removed and replaced with a spare can be readily imagined.

Several new features in breaker design have been incorporated in its type CL circuit breaker by the Westinghouse Electric & Manufacturing Company. Among them are: adjustment of brush pressure, one-piece frame construction which makes installation easy, and unit construction, permitting the addition of various attachments without difficulty.

Oil Circuit Breakers.—The problem of increasing the interrupting capacity of oil circuit breakers already installed without making radical changes in the station layout plans has been met by the General Electric Company by the production of an oil circuit breaker unit which is said to give an increase in interrupting capacity of approximately 40 per cent. Overall dimensions of this unit are identical with those of the lower-rupturing capacity unit which it replaces, except that the tank is somewhat higher. This, of course, makes it necessary to raise the cell tops, lengthen the tie rods of the old cell structures and build up the cell walls to the required height.

Factory built and completely assembled switching equipment has been developed on an extensive scale. These are commonly known as truck type switches. More than 500 of these have been placed in operation in the past year, is the report received from the Westinghouse Electric & Manufacturing Company. Each unit consists of a steel housing with a removable truck carrying all the apparatus upon which continuity of service depends.

During the year a new line of safety, enclosed switchboards with removable truck-type panels has been put on the market by the Condit Electrical Manufacturing Company of South Boston, Mass. Housing and truck are of heavy, reinforced steel-angle construction. The truck is provided with removing and replacing bar and adequate mechanical interlocks. A steel panel carries the face plate for manually- or electrically-operated circuit breakers, meters, indicating lamps, etc. Automatic safety devices prevent accidental contact with current-carrying parts when the truck is removed for repair or overhauling.

Oil Cleaners.—A device for making dirty switch oil as good as new is reported by the Sharples Specialty Company of Philadelphia, Pa. This device is known as the Sharples Super Centrifuge and the company informs us that it accomplishes the following: Carbon and moisture are removed. Resistance to emulsification is restored. The reconditioned oil is light-colored, clean and will meet dielectric strength specifications. It will give the same length of service as new oil.

A new and improved type of blotter-type, oil filtering outfit has been developed by the Westinghouse Electric & Manufacturing Company. This replaces the 10-gal. outfit formerly

(*Please turn to page 106*)

Some Recent Developments in

Maintenance Tools and Repair Shop Equipment

That Have a Wide Range of Usefulness; Do Better Work Than Homemade Makeshifts, and Are No More Expensive in the Long Run

A thorough cleaning of machines is possible by the use of a portable blower. This blower, made by The Martindale Electric Company of Cleveland, Ohio, not only forces a blast of clean, dry air over the surface to be cleaned, but also can be used as a suction cleaner.

MAINTENANCE of plant equipment is always with us and cannot be neglected for long without disastrous results to quality or quantity of production.

Maintenance is often looked upon as a necessary evil because of the number of men seemingly unproductively engaged in the upkeep of the plant equipment. Plant maintenance involves an infinite variety of repair jobs requiring various kinds of tools.

With ordinary kit tools a man engaged in maintenance work can spend considerable time on a simple job or else bring it to the repair shop to take advantage of better tools, but this method consumes time not only for dismantling the broken machine but also for taking it to and from the repair shop.

The solution of the problem of reducing maintenance expense lies in substituting for kit tools, portable power-driven tools, that enable the repairman to do his work in shorter time, with less dismantling of equipment, and the saving of time spent in going to and from the repair shop.

Likewise, repair shop costs can be reduced through the use of improved shop tools that can do better jobs and more of them, in less time than was formerly considered necessary. In addition to the items mentioned, there is also an increase in the life of the repaired equipment obtained through the use of better repair materials.

Manufacturers are endeavoring to meet this need for cheaper maintenance by producing improved tools for maintenance and shop use, by supplying improved repair materials, and by increasing their facilities for supplying repair parts in less time than was formerly required.

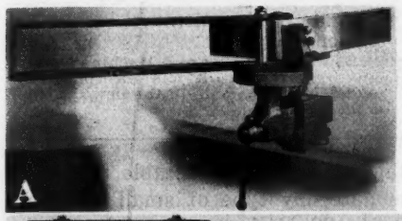
HOW CAN I reduce my maintenance and repair cost, is the problem that is constantly before every maintenance executive, be he maintenance engineer, superintendent, foreman, or straw boss. During the past year many manufacturers have devoted much effort towards arriving at the solution to this problem. In this article are described some of the recent developments in repair shop and maintenance tools and supplies that will help you reduce your maintenance expense.

Great strides have been made in the use of arc welding for plant maintenance; likewise there have been developments in coil winding machines, armature repair equipment, portable power-driven tools, and repair supplies.

We will consider each of these developments in turn.

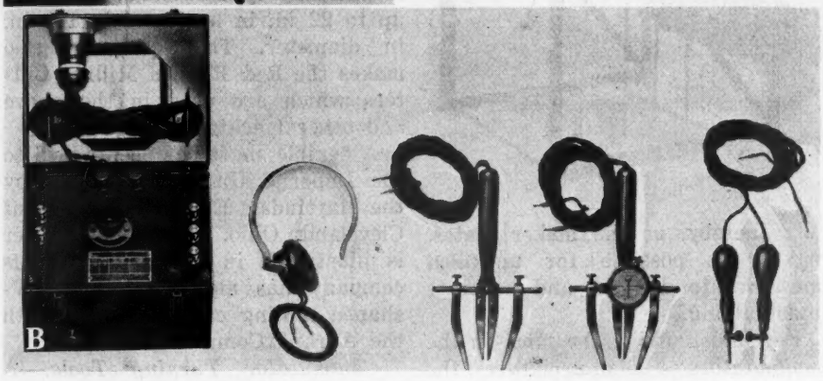
Armature Coil Winding Machines.—During the past year the Armature Coil Equipment Company of Cleveland, Ohio has placed three new coil winding and forming machines on the market.

The first of these, known as the Master Coil Making Machine not only winds the coils but forms them in the same machine. Coils are wound in a loop shape over winding jaws as shown in one of the accompanying illustrations. One of the features reported for this part of the operation is that the loop is started and finished in the same position, thereby eliminating the



Good repair work is a natural result from the use of good tools.

At *A* is shown a bus bar or sheet metal bender made by the Albert & J. M. Anderson Manufacturing Company of Boston, Mass. *B* is a new model armature tester made by The Century Electrical Company of Syracuse, N. Y. The maker reports that this model is designed for use on all commercial alternating-current voltages.



necessity of making an extra half-turn of the machine before starting each loop.

The next operation is to release the coil from the winding jaws by a single universal lever movement that permits a simple, quick-action chuck to receive the coil end. The coil is then clamped in two sets of jaws and formed by pushing down on the foot lever of the machine. Coils that require complete taping are wound, formed, bound and then removed from the machine for taping. Coils that have only the ends taped are taped in the machine after forming.

This company has also made several very useful improvements to its loop winding and coil forming machines. One of the points featured by the maker is that scales have been added to both machines so that they can be set for certain definite measurements taken from the coil, thus doing away with the cut-and-try method of setting a machine to make a certain coil. The manufacturer reports that measurements for a given coil can be recorded in a card record system and a coil reproduced by setting the machine according to the values recorded on the card.

The data recorded on an armature winding card would ordinarily be the size, type, make and nameplate rating of the motor; number of coils; the size of wire used in the coils; the number of wires in multiple; the length of the leads; and how the coils are taped. In addition to this the following information would be recorded for use with these machines: length of loop, length across the core, slot pitch and coil span.

In one of the accompanying pictures is shown the improved loop winder which is known as the New Super-Speed Loop Winder. On the bar holding the winding jaws will be noted a scale marked in inches. By means of this scale the length of the loop is set. The maker states that an additional feature of this winder is the quick time in which a loop may be removed and the machine reset for the next loop—a single quick-action lever accomplishing the operation.

The coil is then placed in the New Improved Armature and Stator Coil Former which is also shown in an accompanying illustration. The forming jaws are set on a scale marked in inches for the length of the coil measured across the armature core. These forming jaws rock on a shaft which has a dial calibrated in degrees. The slot pitch in degrees is set on this dial. The coil span measured in degrees is set on still another dial.

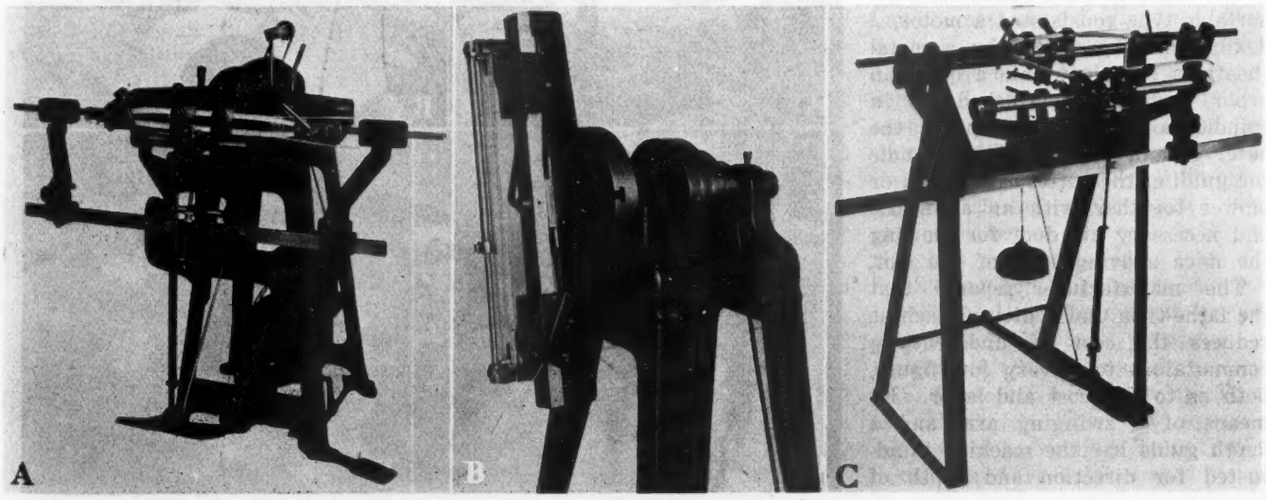
The manufacturer states that in this manner all the dimensions of the coil are thus set on the machine and consequently the coils may be reproduced at any time from recorded data without the use of cut-and-try methods.

Improvements have been made to the reel rack and tension device made by the Mutual Foundry & Machine Company of Atlanta, Ga. The maker reports that unusual results have been secured when using this device on cotton covered magnet wire.

W. Edlich of Delawanna, N. J., reports that he is handling the R. Ritter armature winding machine, which is manufactured abroad. These machines are made in two sizes which will wind coils directly

Three new coil-winding machines developed by the Armature Coil Equipment Company, Cleveland, Ohio.

At *A* is shown a combination coil winder and former. *B* is a coil winder and *C* the former that goes with it. A feature of these two machines is that all of the essential measurements of the coil may be set on graduated dials or scales and thus the coil is made to measure.



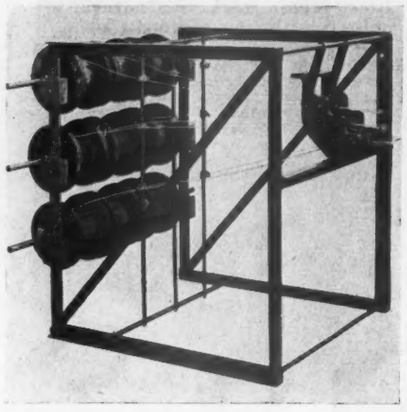
into the armature slots on armatures from 1½ in. to 7 in. in diameter. Mr. Edlich states that a remarkable saving in time can be obtained by the use of this machine as compared to hand-winding methods.

Armature Testers.—A new model armature tester has been placed on the market by The Century Electrical Company of Syracuse, N. Y. The maker reports that this tester instantly detects and exactly locates shorts, opens, wrong connections, and grounds, in armatures, without the necessity of unsoldering any lead wires from the commutator or disturbing the hoods. It may be operated from either alternating- or direct-current circuits, or from a battery when power circuits are not available. The tester is provided with both receiver and meter types of testing forks, and a ground detector. A trouble, or search lamp, is supplied which the maker states is a very useful article and saves much time because it can be inserted behind commutators or into small spaces between windings where a large lamp would be of little use. The tester is shown in an accompanying illustration.

Commutator Slotters.—Several new commutator slotters or mica undercutters have been placed on the market during the past year. The Hullhorst Micro Tool Company of Toledo, Ohio, has designed a portable- and a lathe-type mica undercutter (both of which are shown in accompanying illustrations) as well as an undercutting machine for small armatures. A feature of these three undercutters is the very small cutting tool that is used—a cutter ¼ in. in diameter being used for a 1/32-in. cut and a 3/32-in. diam. cutter for a 3/64-in. cut.

The manufacturer states that the portable type consists of a motor, a flexible shaft protected by a metal sheath, a spindle within a quill, an arbor removably attached to a spindle, a bearing to support the outer end of the spindle, a handle for guiding the cutter, and a fan or blower together with an air-nozzle and necessary air duct for blowing the mica shavings out of the slot.

The manufacturer reports that the lathe-type undercutting machine reduces the cost of undercutting commutators to a very low figure, both as to tool cost and labor. By means of a swinging arm and a depth guide bar the machine is adjusted for direction and depth of cut; thereby, as the maker states, making it possible for unskilled operators to do fast and accurate undercutting.



A handy combination reel rack and tension device.
The Mutual Foundry and Machine Company reports that it has incorporated several improvements in the new design of this device.

For undercutting the mica in the commutators of small armatures, the Ransom & Randolph Co., Toledo, Ohio, has recently placed on the market an undercutting machine that is quickly adjustable to accommodate any type of small armature up to 22 in. in length and 11⅞ in. in diameter. This company also makes the R & R Mica Milling Cutters which are used in the above and other machines.

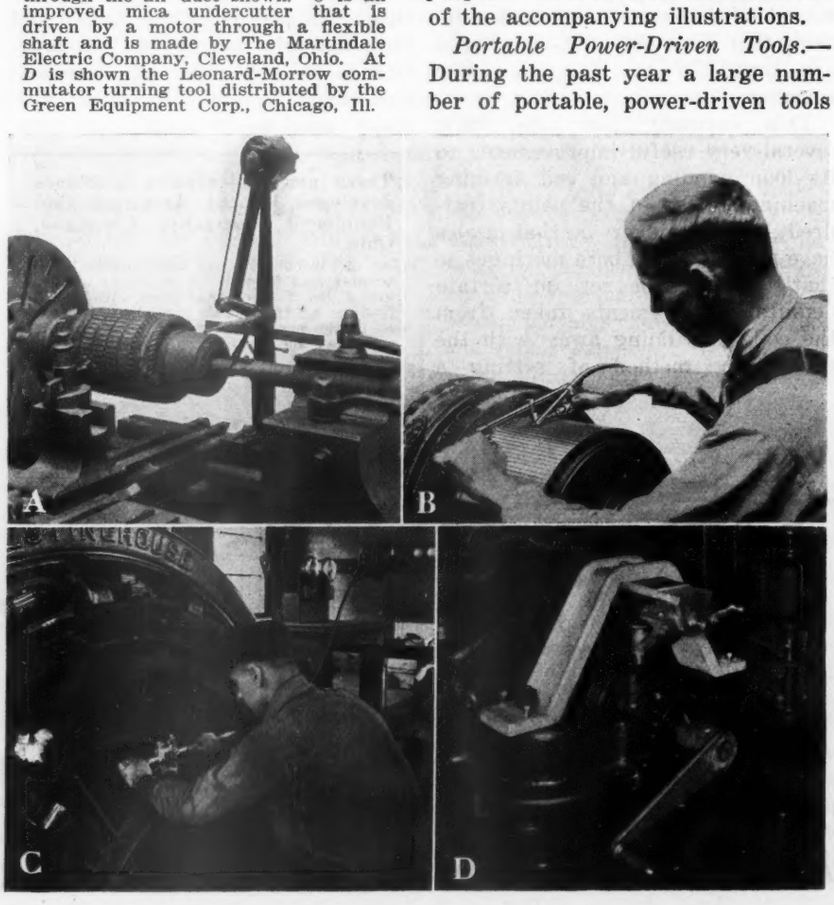
A flexible shaft has been added to the Imperial Undercutter made by the Martindale Electric Company of Cleveland, Ohio. This undercutter is illustrated in this article. This company has also developed a V-shaped milling cutter for use with the Aurand Commutator Slotter.

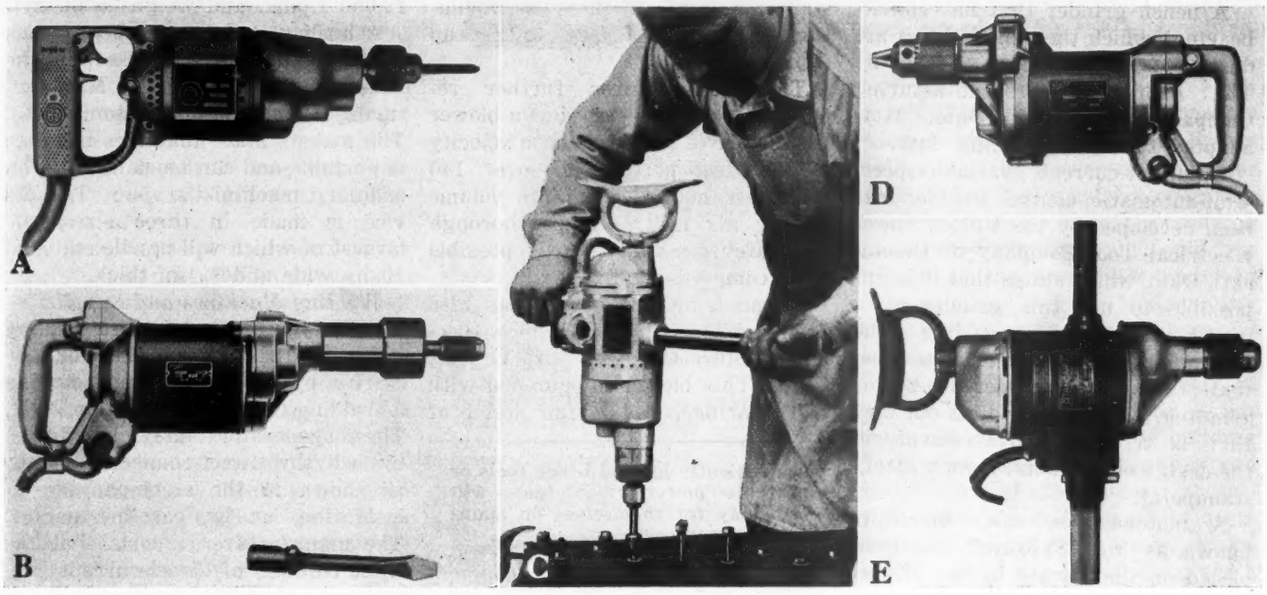
Commutator Turning Tools.—A tool for truing the commutators of motors or generators without removing the armature from its bearings has been put on the market by the Green Equipment Corporation of Chicago, Ill.

The maker reports that with this tool a perfectly true, smooth surface can be made in the same manner as in a lathe, the commutator being turned either by its own power, a crank or a separate motor for that purpose. This device is shown in one of the accompanying illustrations.

Portable Power-Driven Tools.—During the past year a large number of portable, power-driven tools

Four commutator tools designed for fast, high-grade work.
At *A* is shown the lathe-type, mica undercutting machine made by The Hullhorst Micro Tool Company of Toledo, Ohio. This device can be quickly attached to any lathe and is so arranged that it can be swung out of the way when not in service. At *B* is shown the portable, mica undercutting machine made by the same company. It is driven through a flexible shaft by a small motor which has a fan that blows through the air duct shown. *C* is an improved mica undercutter that is driven by a motor through a flexible shaft and is made by The Martindale Electric Company, Cleveland, Ohio. At *D* is shown the Leonard-Morrow commutator turning tool distributed by the Green Equipment Corp., Chicago, Ill.





Here are five portable tools that can save money on any repair job. At *A* is shown a motor-driven tapper made by The Black & Decker Manufacturing Company of Towson, Md. *B* is a motor-driven, friction-head, screw-driver made by The Hisey-Wolf Machine Company of Cincinnati, Ohio. At *C* is shown a motor-driven, reversible socket wrench manufactured by The Black & Decker Manufacturing Company. *D* is a portable, slow-speed drill for drilling slate and marble. It is made by The Hisey-Wolf Machine Company. At *E* is shown an improved model, portable drill manufactured by The Standard Electric Tool Company, Cincinnati, Ohio.

have been placed on the market. These are of particular interest to the maintenance man for they enable him to bring the facilities of the repair shop to the job in hand.

Several new portable drills have appeared on the market during the past year. A slate and marble drill has been developed by the Hisey-Wolf Machine Company of Cincinnati, Ohio. Since the drilling of such material can be accomplished only at slow speed, this drill has been designed for a no-load speed of 110 r.p.m.

An improved ½-in. drill weighing 17 lb. and equipped with ball bearings has been placed upon the market by the Standard Electric Tool Company of Cincinnati, Ohio. The two drills which have just been mentioned are shown in the illustrations accompanying this article.

The Temco Electric Motor Company of Leipsic, Ohio, has developed two new portable, motor-driven drills, one in the ¼-in. size and the other for 5/16-in. drills. This company has also put on the market a drilling stand to hold its portable drill so that the combination may be used as a drill press when desired. By the use of a bench clamp and by fitting the chuck with a Temco arbor and grinding wheel, the ¼-in. drill may be used as a bench grinder. The maker states that this constitutes a very flexible and economical arrangement of portable tools for the small shop.

A friction-head, motor-driven screw driver, that is said to have sufficient capacity to drive No. 14 screws, 2½ in. long into solid soft wood, has been placed on the market by The Hisey-Wolf Machine Company of Cincinnati, Ohio. The maker states that by the use of the proper sockets, this machine can be used for setting nuts up to and including ⅜ in. in size. The driving head is equipped with a disk friction clutch that is automatically regulated by the pressure applied. The clutch casing is of convenient size and can be used as an end grip when the work requires it.

A motor-driven, reversible, socket wrench has been developed by The Black & Decker Manufacturing Company of Towson, Md. This machine is essentially the same in construction and design as the Black & Decker Portable Electric Drill except that the spindle is provided with a clutch that automatically releases when the forward pressure on the tool is relieved. The maker states that due to the design of this clutch, a nut, bolt or stud can be driven to any desired tightness. A reversing switch is provided for use in disassembling motors and machinery and the wrench has ample power to kick nuts or bolts loose, regardless of how tight they are drawn up.

This company has also developed a motor-driven tapper. The maker reports that this device is so designed that the tap is driven in at a speed of 350 r.p.m and, by a slight backward pull on the machine, the tap chuck is automatically reversed and the tap backed out of the threaded hole at double the speed it is driven in. No reversing switch is needed.

A bench grinder for quickly and accurately grinding twist drills up to ⅝ in. in diameter has been placed on the market by The Black & Decker Manufacturing Company of Towson, Md., according to reports received from them. The maker states that the twist drill is fed to the grinding wheel by means of a micrometer screw feed, and that no adjustments are necessary for grinding different size twist drills, this being compensated for in the design.

Heretofore, small repair shops have had to depend upon "free-hand" methods of grinding twist drills because they could not obtain a machine to do the job quickly and accurately at a price which could be afforded. The maker feels that this grinder fills a long-felt need and its use will insure twist drills being ground at the right angle, with proper clearance and with both cutting tips exactly the same length.

A 6-in. bench grinder has also been placed on the market by The Hisey-Wolf Machine Company of Cincinnati, Ohio. This company has also developed a wide-swing, floor-stand grinder, which is especially adapted to grinding large bulky castings and irregular-shaped pieces.

A bench grinder that has spindle bearings which the maker states are dustproof has been developed by The Azor Motor Manufacturing Company of Cleveland, Ohio. It is adapted for light grinding duty.

A direct-current, variable-speed, semi-automatic control grinder has been developed by the United States Electrical Tool Company of Cincinnati, Ohio, which states that it is impossible to use this grinder at a peripheral speed exceeding the maximum safety point or at a speed that is less than considered best for grinding. The maker points out that this is a great advancement in the design of grinders, from a safety standpoint.

A motor-driven saw, which is known as the "Skilsaw," has been placed on the market by the Michel Electric Hand Saw Company of Chicago, Ill. How conveniently this saw can be used to cut out sections of an old floor is shown in an accompanying illustration. The maker reports that the saw is extensively used for cutting open boxes without endangering their contents. He also states that it can save money wherever there is sawing to be done for maintenance or repair work about the plant. Special cutters are provided for use when sawing various building compositions and insulating materials and the device can also be fitted with abrasive discs for work in light sheet metal, bars or tubing.

The maker states that the essential features in connection with the construction of this tool are an 8-in. circular saw or cutter which is readily detachable and is driven by means of a worm connected to the armature shaft of a universal motor. The entire body is made of aluminum. The long guide encircling the saw supports the tool when in operation and is vertically adjustable to limit the depth of the cut. A spring steel guide at the rear of the saw is made of the same gage as the saw itself and follows in the kerf, thus preventing twisting of the saw blade while in use.

The Imperial "Blow-er Clean," a motor-driven blower, has been put on the market by the Martindale Electric Company of Cleveland, Ohio. The maker states that this device, which is shown in one of the accompanying illustrations, operates perfectly as a suction machine or as a blowing device in removing coal dust, dirt and accumulations from machinery, particularly electrical installations, where these accumulations have a tendency to set up short-circuits.

The manufacturer further reports that when operated as a blower the air leaves the nozzle at a velocity of 200 feet per second—over 140 miles per hour. The large volume of dry air insures more thorough and safer cleaning than is possible with compressed air.

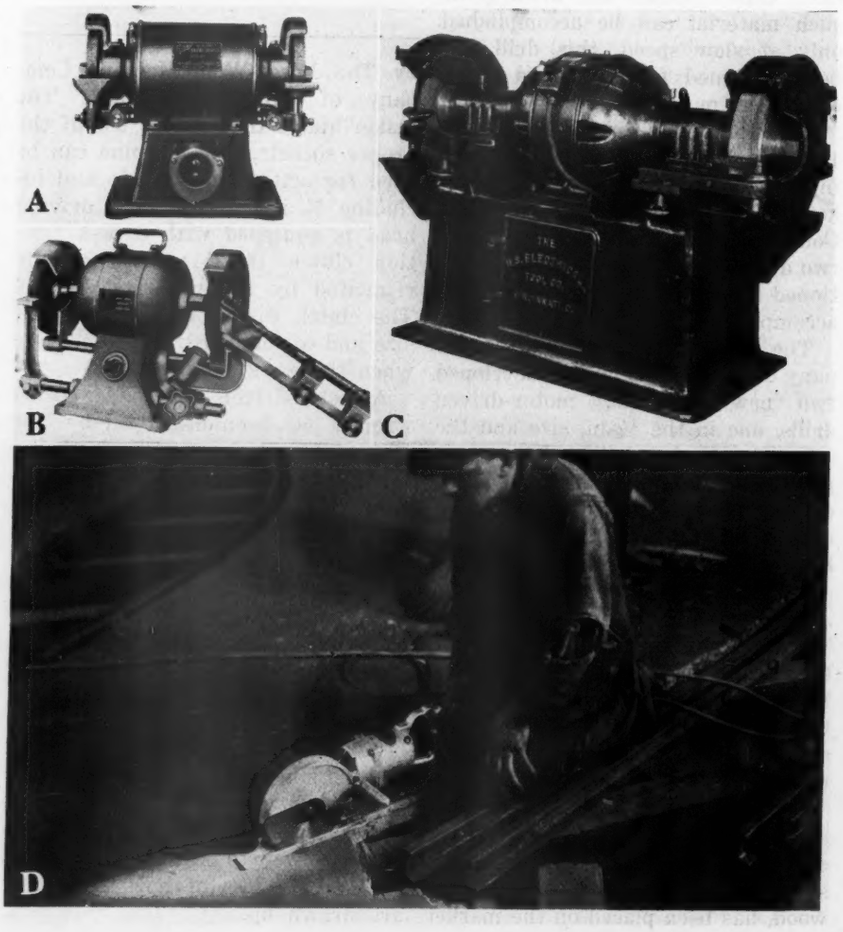
A motor-driven blower has also been developed by the Temco Electric Motor Company of Leipsic, Ohio. This blower is equipped with ball bearings, has a fan speed of 12,000 r.p.m., and weighs 5 lb. net.

A busbar or flat-metal bender has been placed on the market by the Albert & J. M. Anderson Manufacturing Company of Boston, Mass. The makers state that this machine is portable and can be clamped in an ordinary machinist's vise. The device is made in three sizes, the largest of which will handle material 10 in. wide and ⅜ in. thick.

Welding Machines and Supplies.—A new type of electric, arc welding generator has been placed on the market by the Allan Manufacturing & Welding Company of Buffalo, N. Y. These generators may be driven by belt, by direct-connected motor, as shown in the accompanying illustration, or by gasoline engine. The manufacturer reports that the chief troubles of direct-current generators are in the commutator and the difficulty in replacing burned-out armature coils; these two troubles are entirely eliminated in his welding generators for two slip rings replace the commutator, and either eight or ten armature coils, depending upon the speed of the machine, replace the many coils of direct-current, welding generator armatures. In addition to the two above-

Conveniently located bench tools or portable power-driven tools will soon pay for themselves on maintenance work.

A is a small bench grinder made by The Hisey-Wolf Machine Company of Cincinnati, Ohio. *B* is a drill grinder and bench grinder made by The Black & Decker Manufacturing Company of Towson, Md. At *C* is shown a variable-speed, semi-automatic control grinder manufactured by The United States Electrical Tool Company of Cincinnati, Ohio. The maker states that it is impossible to overspeed this machine or to run it at a speed lower than is considered best for grinding. *D* is a portable, power-driven saw, known as Skilsaw, which is shown cutting flooring. It is made by the Michel Electric Hand-Saw Company of Chicago, Ill. The maker states that this machine will also cut building compositions and insulating materials as well as light sheet metal and bars or tubing.

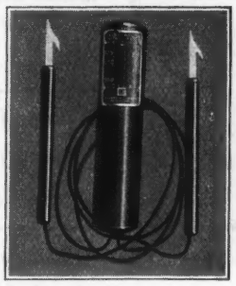


mentioned advantages, there are no complicated windings or connections of field coils. The maker also states that this welding generator has embodied in it the semi-arc feature for use in connection with the welding of light, cast-iron sections, particularly defective automotive cylinder blocks.

A new single-operator arc welding machine rated at 200 amp. has been placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The manufacturer reports that this machine will operate over a much wider range of current than previous machines, has better welding characteristics and has been very much improved and simplified in general construction. The outstanding feature of this machine is said to be its ideal current characteristics which make it easy to strike and maintain the arc, thereby giving good fusion and homogeneous welds. This machine is shown in an accompanying illustration.

A welding machine that will operate from any industrial power supply has been developed by the Electric Arc Cutting & Welding Company of Newark, N. J. The maker points out that by means of multiple, series-multiple and series combinations of the coils of the primary winding, together with taps and adaptor windings, the welder can be made to operate on 110, 220 or 440 volts, alternating current, of 25, 40 or 60 cycles. It is also claimed that by the use of a resistor-reactor combination inserted in the secondary winding, the welder can also be operated from a 110- or 220-volt, direct-current power supply. This company also informs us that a final decision of the patent litigation involving its welding machines has been rendered in its favor by the Circuit Court of Appeals of the District of Columbia.

A new type of direct-current arc welding generator in which the adjustment of the welding current is obtained by shifting the generator brushes has been developed by the General Electric Company. This machine is rated at 250 amp., 1 hr., 50-deg. rise, and 200 amp. continuous, and is also capable of handling a maximum welding current of 300 amp. This manufacturer reports that the use of automatic arc welders showed a consistent gain during the past year, and new types of machines were produced for use in manufacturing them.



A voltage tester is a convenient tool for the repair man.

This tester is made by the Square D Company of Detroit, Mich. In the top illustration is shown the new brick and cement drill made by the Van Expansion Bolt Manufacturing Company of Chicago, Ill.

H. Kleinhans Company of Pittsburgh, Pa., reports that it has developed a gasoline-engine-driven welder and a motor-driven welder which have unusual operating economy, inasmuch as the welding generator generates only sufficient voltage to supply the arc and lead voltage drop, thereby doing away with the losses due to an external resistance or control apparatus.

The Lincoln Electric Company of Cleveland, Ohio, reports that it has improved its arc welder by building the frames of the generator and motor of rolled steel instead of castings. This has brought about a decrease in weight for a given size of welder and at the same time gives a more rugged machine than formerly built. This machine is shown in one of the accompanying illustrations.

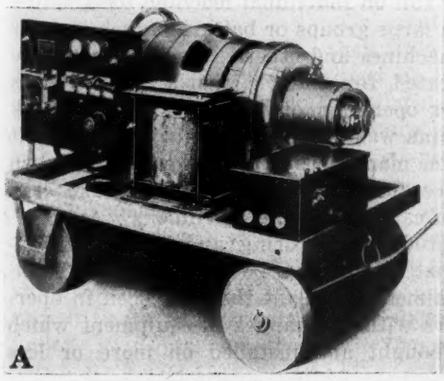
A new welding electrode which the maker informs us differs radically from other electrodes in its makeup and characteristics, has been developed by the General Electric Company. This electrode consists of a central metallic core surrounded by a layer of flux, which is protected by a metallic sheath. The maker points out that this special construction, together with the use of a special flux, results in unusual arc stability, ease of manipulation and rapid deposition. The electrode can be used on either alternating- or direct-current systems and is particularly recommended by the maker for welding cast iron and galvanized iron.

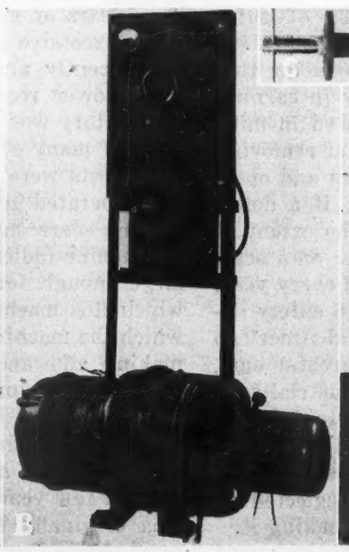
A new type of welding electrode holder marketed by the General

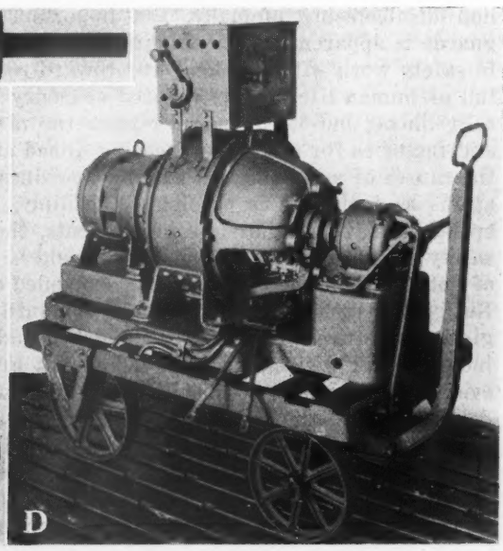
(Please turn to page 110.)

Arc welders have definitely shown their money saving possibilities in industrial plants.

Here are three new or improved arc welders that have been put on the market during the past year. The one shown at *A* is made by the Lincoln Electric Co. of Cleveland, Ohio; *B* is made by the Allan Manufacturing and Welding Company of Buffalo, N. Y.; and *D* is made by the Westinghouse Electric & Manufacturing Co. The machine at *A* is an improved model in which rolled steel has been substituted for cast steel in the motor and generafor cast steel in the motor and generaweight. *B* is an entirely new machine. The outstanding feature of the welder shown at *D*, as stated by the maker, is its ideal current characteristic. *C* is a new electrode holder developed by the General Electric Company.







INDUSTRIAL ENGINEER

Devoted to the Maintenance and Operation of Electrical and Associated Mechanical Systems in Mills and Factories

DANIEL H. BRAYMER
Editorial Director

Assisted by

G. A. VAN BRUNT F. E. GOODING A. J. WHITCOMB

Chicago, February, 1925

Industrial Accidents Cost a Billion Dollars a Year

IN A recent report the Metropolitan Life Insurance Company has pointed out that industrial accidents cost this country every year not far from $1,000,000,000. This startling figure is due to about two and a half million to three million accidents a year that result in a loss of more than one day's working time. The principal types of permanent partial injuries are: fingers and thumbs, 57.7 per cent; eyes, 7.6 per cent; legs, feet and toes, 5.9 per cent; arms and hands, 3.8 per cent. Although the percentage of eye disabilities is relatively low, it is most serious, for the loss of an eye cannot be corrected by artificial methods in the way that these corrections can be applied to legs, arms, and hands.

The distribution of fatal accidents places manufacture second to transportation with these two groups of work sharing about equally 48.3 per cent of all fatalities; agriculture and mining account for about 15 per cent each, construction about 9 per cent and all other work about 12 per cent.

With manufacture charged with nearly one-quarter of the fatal accidents to 4,200 to 5,700 persons each year, coupled with two and a half million to three million disablements annually, the importance of safeguards is apparent to any thinking persons. Education in safety work will go a long way toward reducing this toll of human life and its reduced efficiency in earning a livelihood, but it can never replace the need in mills and factories for safety engineering aimed at removing the causes of accidents and making machines and operations as foolproof as possible. Certainly, if a dollar spent will save a dollar loss in accidents, the extent of safety engineering in this country should be on a scale of not less than one billion dollars expended every year. But such a result can not be hoped for until safety engineering is more universally established and American industry can well afford to spend now a greater sum, even up to four or five times the cost of industrial accidents, to stem the tide of accident losses in life and loss of production time, and wait for its return during the next decade. Such a contribution to humanity will prove a wise investment that should be neglected no longer. There are many good reasons for making it.

A good way to start is to join the National Safety Council and plaster your plant with its effective safety bulletins. Then organize a safety engineering department and eliminate the death- and accident-traps throughout your works.

New Industrial Contruction During 1925

THE building program for 1925 as forecast by the *Architectural Forum* will call for an expenditure of around five billion dollars in new buildings. Seven of the 19 groups of construction work that are reported and call for an expenditure of more than 300 million dollars each, account for 66 per cent of the total of five billions of dollars. Industrial buildings are listed as fifth in the group of seven at a cost of $392,367,000, with hotels and churches each calling for about the same amount. Schools head the list with a cost of $726,858,000 which, with the exception of apartment construction, represents nearly twice the cost of any one of the seven largest items.

In percentage the industrial building program calls for more than seven per cent of the total expenditure and about the same as in 1924. This is healthy growth and seems to be pretty evenly divided for all sections of the United States, with the largest percentages assigned to the Middle West and Northeastern states.

This amount of new industrial construction is going to call for much new electrical and mechanical work and many changes and rearrangements in the complete works where this new construction will extend or add to existing plant facilities. Careful planning of plant layout is called for in this new work and we hope with the co-operation of our readers to present in these columns during the coming year the results of the best thinking it will represent.

Saving Half On a Belting Installation

READERS are familiar with the more or less common practice of using recording instruments on the power line to a machine to see whether it is under- or over-motored and as a check on whether wear in bearings, gears or moving parts has become so great as to cause excessive loading.

Recently another unusual use has been made of these power recording instruments. A large automobile factory was planning a new layout and rearrangement of many of its machines. Before the change was made tests were run on individual machine tools which were operated in large groups or batteries, such as gear cutters, screw machines and others. Tests on one type of machine indicated, for example, that a 2-in. belt was large enough for operation on the special, light work which this machine was doing, instead of the 5-in. belt which the machine manufacturer had provided for when making allowance for a drive which would take care of the maximum capacity of the machine.

A similar study of motoring and belting of machines to see what savings can be made will pay handsome profits in almost any plant that has been in operation a few years without changes in equipment which was originally bought and installed on more or less

guesswork as to the best kind of drive to use. Of course, if a machine is operating on general work it may not be advisable to go much below the manufacturer's recommendation for the power drive. However, many machines are on straight production with light loading which never changes and here is one instance where the machine and its drive should be suited to the job being done and not to the possible range of work on which it can be used.

Making Research Data Usable to Practical Men

READERS of INDUSTRIAL ENGINEER have noticed, perhaps, that its pages have been almost entirely free from papers describing elaborate researches or highly technical discussions on theoretical subjects. There has been a reason for this.

Research and theoretical discussions have a very important place and value and should not be depreciated. This place is, however, where the design of equipment originates. The practical operating man with his multitude of duties seldom has the time nor opportunity to thoroughly digest these papers and determine how the useful findings may be applied to his work.

Recently a prominent practical engineer, well known to the readers of this paper, mentioned the value of "translating" and "practicalizing" some of these reports so that the findings can be more readily appreciated and applied by plant men. In speaking of a recent report on belt drives, which are closely associated with his work, he remarked: "There is mighty good stuff in that report but it would take me at least a full day to make it usable. I am glad to learn that the laws controlling this work have been determined but I cannot give this report to an assistant and let him apply it. This report is meant for engineers who devote their whole time to this subject, which, to me, is only one item of my work. Couldn't the Editors of INDUSTRIAL ENGINEER or some other practical men put this information into charts, curves, tables or diagrams which would give us the results in five minutes with only simple calculations?"

Perhaps other readers have had similar ideas. INDUSTRIAL ENGINEER is making an investigation of the report in question and the readers will benefit from it shortly. The Editors are always anxious to hear of an opportunity to be of service to their readers in this way.

Watch Your Scrap Pile

ON a recent trip through a large industrial works, we were impressed by the clever use of a great deal of material that otherwise would have been scrapped as having outlived its usefulness.

A steam-engine-driven ventilating fan was to be removed to a new location where space was at a premium and where no steam supply was available. Instead of incurring the additional expense of a new direct-connected, motor-driven fan, it was decided to remove the steam engine from the present fan. The fan was taken off the crank shaft of the engine, a new shaft installed with a pulley on it, and the outfit connected up to a short-center, belt drive using an idler pulley. This enabled the outfit to go into the space available and resulted in a saving of not only money but also the time required to obtain the new fan.

At another place in the same plant, a flywheel and drive pulley were required for a coal crusher. Two flywheels from a discarded gasoline engine were put on the same shaft. This gave the required flywheel effect and their rims made a good pulley.

At one of the substations of this plant, three 25-cycle, 12,000-volt transformers were required to carry expected additions to the plant load. At one of the other plants of this same company, there were three 25-cycle, 20,000-volt transformers which were about to be consigned to the scrap pile on account of the substitution of 60-cycle for 25-cycle power. The transformers were opened up and rearranged for 12,000-volt operation. As the transformers were each rated at 500 kva., it meant quite a large money saving to the company.

These instances point out the fact that old equipment should not be scrapped just because the present need for it has ceased. A time may come when very good use of it can be made and will result in a considerable saving of capital investment. Oftentimes the use of this equipment will enable changes to be made that would not otherwise be considered because of the appropriation that would be required.

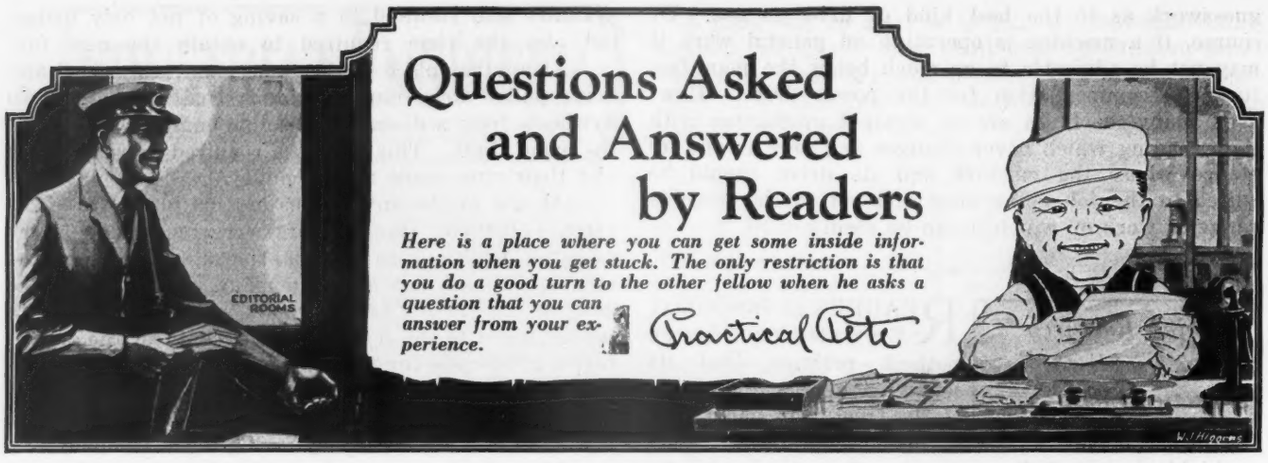
Teach Your Men Signs of Trouble in New Equipment

COMMENTING on the use of ball bearings in his report on changes which were made during the past year, H. D. Fisher, Plant Engineer of the New Haven Pulp and Board Company, makes the following significant statement in the article beginning on page 52 of this issue:

> We have not gone extensively into the use of ball bearings * * *. Further, until our men are more familiar with the signs which these bearings give of impending trouble we fear that we would have a disproportionate number of failures. We attribute the rather excessive trouble with those which we now have to the fact that incipient trouble is not recognized before it becomes serious.

Many plants have unusual operating conditions and there is no doubt that many pieces of equipment, particularly new types, have been unjustly blamed for failure to give service that was up to expectations because the men in charge of the equipment did not know how to take care of it and were not familiar with the early signs of trouble. Detecting trouble and remedying it before it becomes serious is the very essence of maintenance work. Repairs which are made after breakdown occurs are very likely to be much more expensive than they would be if they were made while the equipment was still in operating condition. In addition, there are the inevitable delays and loss of production, which are also expensive.

It is, however, not always possible, or advisable, to put off the installation of new equipment until the operators and inspectors are familiar with its operation and care. Consequently, when new types of equipment are to be installed it is well to secure from the manufacturer or other reliable source as much information as possible regarding the care it should be given and the manner in which signs of distress are manifested. If the inspectors and operators are then thoroughly instructed on these points, so that they will understand clearly what to look for, and where, better results will be obtained and a good deal of trouble and expense may be avoided.


EDITORIAL ROOMS
Questions Asked and Answered by Readers
Here is a place where you can get some inside information when you get stuck. The only restriction is that you do a good turn to the other fellow when he asks a question that you can answer from your experience.
Practical Pete

Who Can Answer These?

Supporting Lineshafting on Concrete Pillars—I have to support several long runs of lineshafting on concrete pillars and should like to know (1) if this is considered good practice. (2) Will it be necessary to use adjustable pillow blocks, or will the solid type be satisfactory? (3) Is there enough danger of the pillars settling or getting out of line to make it necessary to brace these in any way?
Brooklyn, N. Y. C. R. P.

* * * *

Number of Bars Covered by Brushes on Wave-wound D. C. Armatures—I should like to know why the brushes on a 4-circuit, wave-wound, d. c. armature cover only a little more than one segment, instead of two or more segments. I was, until recently, under the impression that the brushes had to cover as many segments as there are circuits per coil. If not, why have the four circuits?
Wichita, Kan. E. E. B.

* * * *

Lay Out of Typical Three-phase Installation—Will some reader give me (1) a diagram of a typical, three-phase power installation from the power company's wires to switchboard, including transformers? (2) What transformer connection is used most, and why?
Windsor, Ont., Can. J. A. L.

* * * *

Using A. C. Generator as Synchronous Motor—What changes, if any, are necessary in order to use a stationary-field, revolving-armature, a.c. generator as a synchronous motor? This is a Westinghouse generator, rated at 25 kva., 480 volts, 30 amp., three-phase, 60 cycles, 1,800 r.p.m., serial No. 4212835. The exciter is direct-connected to the generator shaft and is rated at ¾ kw., 125 volts, 6 amp.

I should like to use this generator as a synchronous motor to drive a centrifugal sugar drier and to correct power factor. The power supply is 480 volts and all motors are rated 440 volts. If I can use this generator as planned, what horsepower will be developed and what will be the ampere input? Will I have to have an outside supply of direct current for excitation, or can I use the exciter on the machine?
Negros Occidental, P. I. A. C. M.

* * * *

Calculating Starting Resistance for D.C. Motors—Will someone please tell me how the amount of resistance that is used in the starting rheostats of shunt, compound and series d.c. motors is computed? (2) How are the different voltages obtained on the various taps of the compensators for a.c. motors and what are their usual values in percent of full-line voltage?
Albert, W. Va. F. H.

* * * *

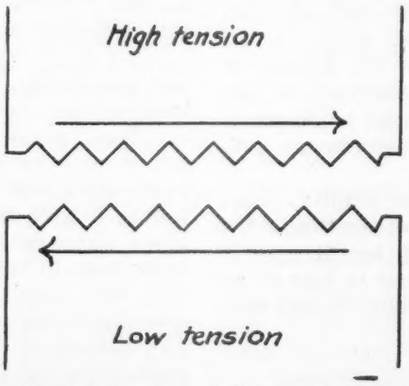
Transformer Draws Heavy No-load Current—We have a 75-kva., 25-cycle, single-phase, 2,200/220/110-volt lighting transformer which draws an excessive no-load current. The primary current with all secondary load disconnected is about 11.5 amp. at 2,200 volts. The secondary voltage is normal at 0, ¼, ½, ¾ and full load. The temperature of the oil is normal. The insulation resistance between windings and between windings and ground is over 50 megohms. What is the cause for this high no-load current?
Hamilton, Ont., Can. J. F. M.

* * * *

Reclaiming Leather Belting—I should like to know if any readers have made an investigation to determine how much belting must be in use before it will pay a plant to undertake belt reclamation work. I should also like to know the amount and kind of equipment required to do such work and about what savings we could expect to make. I shall appreciate any suggestions or information you can give me.
Cleveland, Ohio. E. E. L.

* * * *

Polarity of Transformer—After reading the article on "Checking and Testing Transformer Connections" on page 560 of the December, 1924, issue of INDUSTRIAL ENGINEER, I am somewhat confused as to the relationship between the primary and secondary voltages for transformers of different polarities. Assume a transformer having primary and secondary voltages in the winding as shown by the arrows in the diagram. Can some reader tell me whether this transformer has additive or subtractive polarity, and why?



Chicago, Ill. G. A. V.

* * * *

Reconnecting Two-Phase Motor for Three-Phase Operation—I have a 10-hp., 440-volt, two-phase, squirrel-cage motor which has 48 slots and coils, six poles, and is series-connected. Can this motor be reconnected for three-phase operation by using the "T" connection? If so, how many coils must be cut out of circuit? What will the new grouping be for three phase and what horsepower will the motor develop after reconnection, if the speed remains the same as before? What is the smallest number of coils that can be reconnected from two-phase to three phase by the "T" connection?
Iola, Kan. G. E. G.

Answers Received To Questions Asked

How to Determine When a Wave Winding Is Retrogressive or Progressive—Please indicate by formula or otherwise how to determine when a wave winding is wound progressive or retrogressive and what are the particular advantages of the progressive wave winding over the retrogressive?
Chicago, Ill. H. B. C.

The formula to use for determining when a wave winding is progressive or retrogressive is as follows: $k = (K \pm 1) \div p$. In this formula (K) is the number of commutator bars, (k) the lead pitch on the commutator, and (p) the number of pairs of poles.

In any two-circuit wave winding, regardless of the number of poles or whether the bars are odd or even, the above formula will indicate when the wave winding is progressive or retrogressive. It is retrogressive when the minus sign is used and the commutator pitch comes out a whole number, and progressive when the plus sign is used and the commutator pitch comes out a whole number.

For example, take a four-pole, ninety-seven-bar machine: $k=(97+1) \div 2 = 49$, or a lead pitch of 1-and-50. Then $1+49+49=99$, which means that the coils connected in series and starting on bar (1) will have the finish lead connected to bar (99) or bar (2), which is one bar ahead of the starting point. The winding is progressive.

On the other hand, using the minus sign, $k=(97-1)\div 2=48$, giving a lead pitch of 1-and-49. Then $1+48+48=97$, which means that the series of coils starting at bar (1) would have the finish lead connected to bar (97) or one behind the starting point, making a retrogressive winding.

As another example, when the commutator bars are even, take a six-pole 100-bar machine. Then $k=(100+1)\div 3=33\frac{1}{3}$. The commutator pitch comes out a fraction and cannot be used. Then using the minus sign, $k=(100-1)\div 3=33$, or the commutator lead pitch is 1-and-34. Then $1+33+33+33=100$ and the series of three coils starting on bar (1) would have the finishing lead connected to bar (100) or one behind the starting point and the winding would be retrogressive.

In the case of a 200-bar, six-pole machine, $k=(200-1)\div 3=66\frac{1}{3}$, which cannot be used. Then try the plus sign: $k=(200+1)\div 3=67$ or a lead pitch of 1-and-68. Then $1+67+67+67=202$ for a progressive winding.
Wilkinsburg, Pa. A. C. ROE.

Method of Lining Up Conduit on Ceiling Beams—I wish some reader would please tell me the quickest and proper way to line up ½-in. conduit on the ceilings of mill-type buildings when you are breaking around the beams, using conduiet fittings only at the bottom of the beams and also between beams, for lights. Some say it is best to put all of the pipe clips up first by using a chalk line and plumbing down; then you can take the line down and it will be out of the way. Others say to snap the line and take it down, but this method does not make a mark between the beams. As the thickness of the fittings must be taken into consideration, should one go by the edge of the fittings, by the edge of the pipe or by the center of the pipe? Also, should the clips be put up first? If so, what is gained by so doing?
Worcester, Mass. R. S. T.

Replying to R. S. T. in the December issue, common judgment is to be used in a case like this, taking into consideration the physical conditions of the building in question. There being nothing to prevent, a good way would be to string a chalk line across the ceiling, squaring it with the adjacent walls as far as possible. Snap the line, leaving a chalk line mark underneath each beam. Take a hacksaw and cut a small mark on the edge of the beam, deep enough to be readily seen, but without damaging the beam. Rub a piece of chalk over the cut, and it will fill up with chalk, which leaves a permanent mark that will last for several weeks. It is then an easy matter to string a short line from mark to mark, or from beam to beam, as the work progresses, lining up the conduits with a plumb in each bay or section as these are bolted up

In this method, after the work is laid out there are no long lines to catch on obstructions or be stretched out of true, and your line marks are there for a period much longer than will actually be needed. Try it and be convinced.

Chief Engineer, P. S. PENDER.
Metropolitan Eng. Co.,
Granite City, Ill.

* * * *

Why Can Not This Motor Be Speeded Up?—We have a Westinghouse, type SK, 7½-hp., 1,150-r.p.m., 110-volt motor that is giving us trouble. The nameplate says "Shunt Wound, Continuous Speed," but it has a series field, shunt field and interpoles. For several years this motor ran satisfactorily, until a brush was replaced. The new brush was identical with the old one.

The motor picks up regularly and carries the load, but as soon as the field is weakened to increase the speed the load fluctuates badly; the more the field is weakened the more the load swings until there is a sharp flash at the brushes or a fuse blows. All kinds of connections have been tried, without results. The speed of the motor when running the machine is from 1,150 to 1,500 r.p.m. When the trouble started the machine was running at 1,800 r.p.m. The same trouble occurs with all of the different motors of the same type that we have tried on this machine, although it can be driven satisfactorily by a straight shunt motor of less horsepower rating. Can some reader tell me the cause of this trouble?
Norwood, Mass. E. F.

Referring to the question by E. F. in the November issue, he says that the motor ran satisfactorily for several years until a brush was replaced. I should say that the brush setting was disturbed, as this alone will cause quite a lot of trouble in a motor of this type. He also states that all kinds of connections have been tried without success. If the motor flashes at the brushes or blows fuses with an increase of speed and the load fluctuates badly, it would appear that the fields were improperly connected. If this motor were overfused sufficiently I think he would find that it would come to a dead stop and then start up in the reverse direction, due to the gradual weakening of the shunt field and gradual increase in load due to increased speed, by strengthening the series field and causing it to overcome the weak shunt field, thus making the motor reverse its direction of rotation. I would suggest that he check up the field connections and make sure that the shunt and series fields are connected cumulatively; also see that the interpole polarity for a given pole is the same as the main pole which follows it in the direction of rotation. Then the brush rocker arms should be set so that the coils directly under the interpoles are the coils which are being commutated.
Detroit, Mich. J. J. CONWAY.

* * * *

In reply to E. F's. question in the November issue, it is quite evident that the mere replacing of a brush could not cause the trouble which he describes.

If this motor has operated satisfactorily for several years as a variable-speed machine, it certainly will continue to do so after a new brush has been installed, provided all connections are the same as before.

It is quite evident, from the information given, that the fields do not bear the correct relation to each other for proper operation.

I would suggest that E. F. check the connections again and I am quite sure he will find that the series or interpole winding, or both, are bucking the shunt winding.
Columbus, Ohio. G. B. H.

* * * *

E. F.'s question in the November issue is complicated by the statement that although the nameplate reads "Shunt Wound," the motor has a series field. If the motor really is compounded, the symptoms described would result from trying to run the motor too fast. From the statements made, the motor was running from 30 per cent to 55 per cent over its rated speed, which is stretching the latter quite a bit for a constant-speed motor. Under such conditions the shunt field is so weak that the motor tends to operate as if it were straight series wound. It speeds up until the counter e.m.f. of the motor reduces the armature and series field current to a value which makes the series field weaker than the shunt field. Then the motor slows down and the cycle is repeated until the brushes flash or the fuses blow.

It is stated, however, that this motor ran satisfactorily until a brush was replaced. Is it possible that the brush rocker got shifted while this was being done? If the motor is operated in one direction only, try moving the brush rocker in the direction of rotation. Do this a little bit at a time, say 1/32 in. measured on the face of the commutator. Even a plain shunt, interpole motor will behave as mentioned if the brushes are not correctly placed. But the statement that the same trouble occurs with other motors of the same type would make it appear that the trouble is due to excessive field weakening. Possibly in the years during which the motor was operating successfully it was running at its rated speed of 1,150 r.p.m., since E. F. says that everything is all right until he starts to weaken the field.
Honesdale, Pa. J. M. WALSH.

* * * *

In the November issue E. F. asks for an explanation of a rather peculiar phenomenon occasionally met with in the operation of commutating-pole motors. He is obviously puzzled over the fact that a shunt motor is supplied with a series field, and it may interest him to know that it is put on for the very purpose of preventing unstable operation, which is his trouble.

With the advent of commutating poles there has been a tendency to increase the armature ampere turns relative to the field ampere turns, as there is no longer any need of having a commutating flux fringing off the main pole tip. However, under load the relatively stronger armature increases the distortion of the main field flux due to cross-magnetization, and, as the teeth and pole tips are usually saturated to some extent, the increase in flux on one side of the pole is less than the reduction on the other. The net result is, then, a decrease in total flux per pole, with an increase in armature current.

If the weakening of the field with increasing load is pronounced, the motor speed increases with load and fails to reach a stable point. However, instead of increasing uniformly until the motor flashes over, the speed and armature current frequently oscillate, due to interchanges of energy between the electrical and mechanical systems, the energy being alternately stored as electro-magnetic energy in the motor field and mechanical energy in the rotating parts. To prevent weakening of the motor field with increasing load, the motor is supplied with a small series field and in this case the trouble can no doubt be overcome by adding a turn to the series field.

However, there is another possible source of trouble. If the commutating field is too strong a current circulating in the coils short circuited by the brushes will cause a weakening of the main field with increasing load. Indeed, since in this case trouble commenced after the brushes had been changed, it is probably caused by a circulating current in the coils undergoing commutation. Increasing the commutating pole gap by removing liners from back of the poles, if there are any, or machining a little off the commutating poles, will overcome that difficulty.

A more detailed discussion of the effect of cross-magnetization and the circulating current in the brushes on the motor speed may be had by reference to an article in the *Electrical Journal* for September, 1914, by C. G. Lewis and the writer, entitled, "Speed Characteristics of Direct-Current Motors."

E. F. may be interested in seeing an oscillogram record of the armature current during an unstable condition similar to that which is giving him trouble. He can find such a record in Fig. 10 on page 298 of Vol. XXXVI, of *Transactions A. I. E. E.*, in a paper by the writer entitled "Analysis of Starting Characteristics of Direct-Current Motors." It will also probably interest him to know that the test was made on a motor of exactly the same type and rating, except that it was a 220-volt instead of a 110-volt machine. He will note there that the armature

current would vary from 100 amps. to 25 amps. in the opposite direction. His motor being of half the voltage and twice the current rating, would, of course, show a much wider variation of current under similar conditions.

Milwaukee, Wis. K. L. HANSEN.

* * * *

Jackshaft Bearing of Mill-Type Motor Leaks Oil.—I am having trouble with oil leakage from the jackshaft bearings of mill-type motors. These bearings are large, running from 3½ to 7½ in. in diameter. They are split and held in brackets which are integral with the motor frame. Both ends of the babbitt bearing extend beyond the bearing housing. There is one oil ring in each bearing. The oil leaks out around the shaft at the ends of the bearings and then drips on the surrounding apparatus. At times the oil will be drawn out of the bearing to such an extent that the oil level will fall too low for the ring to dip in the oil.

I shall appreciate it if some of the readers of INDUSTRIAL ENGINEER will give me the remedies they have used to overcome this trouble.

South Chicago, Ill. O. C.

In reply to O. C.'s question in the September issue, without knowing the make of motor, I would say that babbitt bearing linings should not be so long as the bearing housing. Cut them off so that they come, when finished, from ¼ in. to ⅜ in. inside of the bearing housing opening. Also, it is usually very good practice to cut an oil groove from ¼ in. to ⅜ in. in width and a short distance from each end of the babbitt lining, with two or three holes in the bottom half.

The oil ring is placed there for the purpose of carrying oil into the bearing, but it will not carry the oil out; it flows out by gravity. As this bearing has only two openings, one at each end parallel with the shaft, out of which oil can flow, it flows to these openings and then out upon the ground, as it is mechanically prevented from flowing back to the oil well by an obstruction of babbitt extending beyond the bearing housing. If the end of the bearing lining were inside of the bearing housing the oil would drip from the end of the bearing onto that portion of the housing extending beyond the bearing and drain back to the oil well.

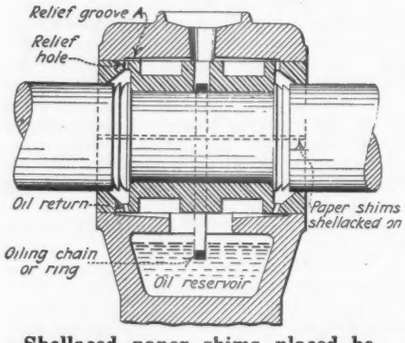
Jackshaft thrust collars were not mentioned, but there should be some form of thrust collar on this jackshaft, two at least, and possibly four. The edge of this thrust collar should carry some form of mist ring or oil thrower; that is, it should not be a flat surface, but of knife-edge design, so as to present the smallest possible surface to which oil can adhere. The oilways cut around the ends of a bearing are put there to provide an outlet from the bearing and the larger the amount of oil one can make flow over the surface of a bearing or shaft in a given length of time, the cooler the bearing will be.

Chief Electrician, A. L. GEAR.
Gary Screw & Bolt Co.,
Gary, Ind.

* * * *

Referring to O. C.'s question in the September issue of INDUSTRIAL ENGINEER, it is somewhat difficult to accurately analyze the cause of the trouble in a leaking bearing without knowing whether the bearing is ring oiled, chain oiled or wick oiled. We will consider that the bearings in question are ring oiled.

The illustration shows a cross-section of a typical bearing arrangement. The oil circulated by the ring creates a pressure which forces it to follow the parting line of the two halves of the bearing toward the outer ends where it clings to the shaft and leaks out. If collars, pulleys, gears, etc., are mounted on the shaft near the bearing, there is a tendency to create a slight vacuum at the ends of the bearing and by reason of the difference in pressure inside the bearing and at its end, the oil is drawn out, leaking down the end of the bearing. Using a heavy oil will not remedy the situation, and will be found to aggravate conditions. Likewise, oil that is thin will flow too freely and leave the bearing in a fine spray.



Shellaced paper shims placed between the bearing halves and a relief groove shown at (A) will prevent oil leakage.

To remedy such leaky bearings a well-shellacked paper shim should be placed at each side between the two halves, so as to close the opening at the dividing line of the bearing halves. Also, if there are no relief grooves in the upper part of the bearing, a groove should be chipped in, extending from the oil-ring chamber to the oil-collecting groove at each end of the bearing, as shown at (A) in the diagram. For general service, a medium oil with a viscosity of 275-310, Saybolt, is recommended. E. H. LAABS.

Engineer, Printing Equipment Dept.,
The Cutler-Hammer Mfg. Co.,
Milwaukee, Wis.

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Method of Running Open Wiring in Mill-Type Buildings—I wish some of the readers of INDUSTRIAL ENGINEER would give me their opinion on the best way of running open wiring in buildings of mill-type construction. Assuming that No. 8 or larger conductors are used, should these be run on the roof trusses, on the ceiling beams or on the side walls? Should the conductors be supported by cleats or on knobs? What kind of cleats and knobs should be used? I should also like to know when and how strain insulators should and should not be used. Is there any preference as to the type of strain insulator? Any information you can give me will be much appreciated.

Worcester, Mass. R. S. T.

R. S. T. asked, in the September issue, for information on wiring a building of mill-type construction. I would run the wires on either the side walls or on the ceiling beams, depending on which location would require the least work and material. The wires should not be run on knobs or in cleats, as this method is used only where the wire is smaller than No. 8. I would suggest that he use two- or three-wire brackets for supports. These may be fastened to the ceiling beams by means of I-beam clamps or bolts, preferably the former. I have solved many problems of this kind by consulting manufacturers' and jobbers' catalogs, and I believe R. S. T., can secure valuable information if he will obtain some of these catalogs.

Insulators should be used at the termination of each run of wire, and sometimes at each end of the run. They should be equipped with a turnbuckle or eye-bolt. This will provide a means of drawing out of the line any sag that comes after the work is completed. If an eye-bolt is used, it should have several inches of threads and the threads in either the eye-bolt or turnbuckle should be filled with heavy cup grease to prevent corrosion. Any type of insulator that meets the Code requirements may be used, but porcelain is preferable.

I might say that Article 5, Section 501 of the 1923 edition of the National Electrical Code will be very helpful to R. S. T.

Moundsville, W. Va. J. H. BLAIR.

* * * *

In reply to R. S. T.'s question in the September issue, running open wiring in buildings of mill-type construction is largely a matter of conditions, but there are some good rules that may be followed. Assuming that the wires are to be run overhead and that there are no cranes or hoists in the building to interfere, they can be run to advantage on the under side of the trusses by using strain insulators at each end of the line, fastening these insulators directly to the ironworks or bolting a piece of angle iron on the under side of the truss work for use as a dead end.

If there are cranes in the building the only place wires can be safely run is on top of the roof trusses directly under the roof boards. In the case of concrete or gypsum roofs run under the top cross member of the truss work and deaden them as in the first instance. Running feeders on side walls is not done extensively by the open-wiring method. Conduit is best on side walls unless feeders are very large, say No. 4/0 or above. Cleats probably will give better service than knobs in open mill wiring as they are not subject to much breakage, due to their generous size for wires of No. 8 gage or larger. They will also make a very neat job if put up in a straight line and evenly spaced.

It is considered good practice to use strain insulators at the ends of all lines on open work in mills. It is very poor practice to make turns with knobs or cleats when running wires of large size. By using strain insulators, wires may be pulled up tight and they will stay tight, whereas, if knobs and cleats are used the wires cannot be pulled tight and if they are to be kept from sagging a very close spacing of cleats will be required unless strain insulators are used.

There is a decided preference in the kind of strain insulators to be used. In

buildings where heat and moisture are excessive porcelain insulators are best. If the building is dry, mica or wood strain insulators may be used. They can all be obtained in any variety of styles and voltages which a particular case may require.

Donnacona, P. Q., Can. LEE F. DANN.

* * * *

Answering R. S. T. in the September issue, for running large conductors in mills strain insulators of the mica-globe type, with eyes or clevices, provide the best means of drawing the lines up tightly, where the run is straight. Even where a right-angle turn is desired, strain insulators may be used, fastened back to a near-by wall or to a beam in such a way that each conductor is staggered up or down away from the next one, where they cross or turn.

When using strain insulators for a job like this, provide a turnbuckle insulator at one end of each conductor, so as to take up slack from time to time.

As for the location of the conductors, this depends upon the location of the load; if all or most of it is near the wall keep the feeders near the wall or high up on the wall.

If the greater part of the load is out on the floor, and the girders just over head have a clear runway with no cranes, long, tight lines stretched where convenient can be neatly installed.

If feeders are placed along the side wall, keep them high above the reach of ladders likely to be placed there, as these are a common source of interference. Feeders should be kept high out of the way in all cases, because they cannot be removed very readily for the unexpected installation of some machine, crane or whatnot.

With the lines drawn tightly, large two-piece porcelain cleats taking two screws each may be placed along the line at intervals close enough to keep it from sagging, but the cleats really hold none of the strain.

I have installed many such lines, up to 500,000 circ. mil. diameter, by using globe and turnbuckle strain insulators at each end, pulling the conductors tight first, and then placing large porcelain cleats on either wood beams or on steel girders.

Jamestown, N. Y. H. S. RICH.

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In answer to the question asked by R. S. T. in the September issue, Article 5, Section 501, Paragraph (K) of the 1923 edition of the National Electrical Code says in part: "In buildings of mill construction mains not smaller than No. 8, where not liable to be disturbed, may be separated about 6 in. and run direct from timber to timber, being supported on each timber only."

In article 5, Section 501, Paragraph (A) the statement is made that supports shall be composed of approved, non-combustible, non-absorptive insulating material, free from checks, rough projections or sharp edges which might injure the insulation on the conductor. If the supports are designed to grip the wires either screws or nails may be used to fasten the support in place, but nails shall be long enough to penetrate the woodwork not less than one-half the depth of the knob and fully the thickness of the cleat. Also, in paragraph (B): "Supports shall provide at least ¼ in. separation between the securing screw or nail and the wire, and shall be designed for two securing screws of the split knob (or single-wire cleat) type intended for wires larger than No. 4."

Personally, I would recommend in your case using knobs screwed in place on each timber, keeping your wires well apart, and if they are in any way liable to mechanical injury, protect them by guard grips not less than ⅞-in. in thickness, and at least as high as your knob. However, for wire larger than No. 6, I would use two-piece cleats secured in position on each timber with two screws. Strain insulators are used at the ends of the runs and unless your lines are No. 4 or larger, it is really not necessary to use them.

Ardsley, Pa. EDWIN V. LAMBERT.

* * * *

Voltage Rating of Fuses for 440-Volt Circuits—Will some reader please advise me as to the proper kind of fuses and fuse cutouts to use on 440-volt, three-phase, 60-cycle circuits? Should I use 600-volt or 250-volt fuses and cutouts? (2) Is it practicable to use fuses above 300-amp. rating as entrance fuses, or would it be better to use a circuit breaker?

Any information that you can give me will be greatly appreciated.

Marion, Ohio. G. R. K.

Referring to the questions asked by G. R. K. in the December issue, 600-volt fuses should be used on 440-volt circuits, because of the inductive effect on alternating-current circuits; 250-volt fuses would not operate satisfactorily. They would be very liable to explode.

As to the second question, it certainly is practical to use fuses above 300-amp. rating as entrance fuses. Entrance fuses burn out very seldom and there could be no possible argument for the use of anything else except a fuse for such service.

Vice-President, H. T. BUSSMANN.
Bussmann Manufacturing Co.,
St. Louis, Mo.

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In reply to G. R. K., whose question appeared in the December issue, (1) In view of your second question I would use 600-volt fuses in preference to 250-volt; 600-volt fuses of 300-amp. capacity can be purchased and are approved by the Fire Underwriters.

(2) It is practicable to use 300-amp. fuses as entrance fuses; even double that capacity can be used by approval under proper conditions. However, if your service is of such a nature that interruptions due to grounds and shorts are common, the use of fuses would not only be impracticable, but contrary to good practice, due to the cost of fuse replacement and the time lost in replacement, as only competent men should replace fuses of such rating. These men may be at a distance when a fuse blows and the time element involved in looking up the electrician is of consequence. I have installed fractional-ampere circuit breakers on the basis of the labor involved in making fuse replacements and they have proved economical. Another point in favor of the circuit breaker is that when it opens this action is readily discovered, whereas fuses require testing, in many cases to find the trouble. In general a circuit breaker can be reset with the minimum danger to incompetent men, it is readily adjustable to a variety of settings, has no upkeep expense other than periodical testing and cleaning and is less of a fire hazard.

Fuses are cheaper, under conditions that admit of their use, are reliable and require no attention; in many places they cannot, however, be used because of their fire hazard.

If from the above you believe, G. R. K., that a circuit breaker better suits your needs, I would suggest that you get in touch with some of the leading manufacturers of circuit breakers, practically all of whom carry advertising in INDUSTRIAL ENGINEER, state your conditions completely and they will give you costs, sizes and any other information desired.

West Allis, Wis. EDWARD JAMES.

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In reply to the inquiry by G. R. K. in the December issue, we can advise (1) that the proper voltage of fuses and cutouts to use on 440-volt circuits are those labeled 600 volts. The 600-volt fuses and cutouts are ordinarily used for voltages above 250 and not over 600. For voltages above 125 and not over 250, 250-volt fuses and cutouts are ordinarily used.

The 250-volt fuses are not designed and intended for use on 440- and 600-volt circuits. The 600-volt fuses have a greater break distance and are of a more rugged design than the 250-volt fuses, so as to withstand the added strain to which the higher voltage may subject the fuses under heavy short-circuit service.

(2) Fuses up to 600-amp. capacity, in both the 250- and 600-volt ranges, when made by manufacturers under the approval of Underwriters' Laboratories, Inc., established and maintained by the National Board of Fire Underwriters, will give satisfactory service as entrance fuses, and from the economical viewpoint should be chosen, since they are less expensive than circuit breakers.

Electrical Engineer, J. L. BROYLES.
Economy Fuse & Mfg. Co.,
Chicago, Ill.

* * * *

Answering G. R. K. in the December issue, the National Electrical Code covers the fusing of 440-volt circuits in every detail and all that he can do is to follow these rulings closely, using the necessary judgment as to loading conditions of the circuit. A non-inductive circuit does not require as heavy a fuse as an induction motor load. It is presumed that the circuit feeds a set of induction motors, as is usually the case. The distribution panel from which the circuit receives current is, if designed by a competent engineer, "switched" and "fused" correctly for the purpose for which the circuit is intended.

Whether the load fluctuates greatly, or is steady throughout the daily cycle of service, must be taken into consideration. Induction motors are fused from 110 per cent to 300 per cent of full-load current, depending on the type of starter and the percent of full-load current taken at starting, but under no consideration are they fused over 300 per cent of their rating. Any motor circuit using 300 amp. and above on 440 volts should be equipped with an auto-

matic circuit breaker, in addition. It is my understanding that fuses can be obtained for all standard ratings.

A good many instances are known where the operators get by with any old arrangement that works half-way, but a first-class job and good construction requires good engineering to begin with, and full protection is the result, not to mention satisfaction to the operators. Manufacturers will supply you with a list of all fuses of standard rating, up to 2,200 volts, and will be glad to furnish you gratis a book or table covering the entire fuse installation.

Chief Engineer, P. S. PENDER.
Metropolitan Eng. Co.,
Granite City, Ill.

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In answer to the question asked by G. R. K. in the December issue, (1) it is customary to use 600-volt fuses on 440-volt circuits, as the length of the 600-volt fuse allows the arc, caused by the rupture of the fuse, to be extinguished more readily.

(2) If the choice lay between the use of a circuit breaker and the use of 300-amp. fuses, it would be more advisable, from an engineering standpoint, to use the circuit breaker. Although there are in use fuses of larger capacity than 300 amp., it is far more economical, in the long run, to use circuit breakers. In my opinion the circuit breaker is more reliable.

Goldfield, Nev. PHIL D. COMER.

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Replying to G. R. K. in the December issue, I would suggest that he use 600-volt fuses and fuse cutouts on 440-volt circuits, because 250-volt fuses would be liable, when the fuse explodes, to arc across the terminals where the fuse links are connected.

As to his second question, if first cost does not matter I would suggest that he install an oil circuit breaker with overload relays and current transformers, as service can then be more quickly restored when an interuption occurs. The wiring diagram for the connections can be obtained from the firm which supplies the equipment.

If the circuit is to be metered at this point the power company may be willing to let G. R. K. use the same current transformers that they use for their meters. They would also probably assist him in making the proper connections. If he does not want to use relays he can use an oil circuit breaker with 5-amp. trip coils.

Galesburg, Ill. EARL BABER.

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Trouble Caused by Plugging Elevator Motor—Will some reader of INDUSTRIAL ENGINEER please give me some help on the following problems? (1) We have a 10-hp., 550-volt, three-phase elevator motor which is controlled by a Cutler-Hammer reversing switch. We are experiencing a good deal of trouble from blowing of fuses due to reversing the motor before the elevator comes to a full stop. This elevator has no regular operator and is used for freight service only. Has anyone had similar trouble and what is the best method of overcoming it? (2) Is it possible to wind a magnet that will lift from 10 to 25 lb. and can be operated on a 110-volt, sixty-cycle circuit? If so, please give me the winding data for 110 volts and also 550 volts.

Millbury, Mass. L. A. T.

In answer to L. A. T. in a recent issue, the reversing switch on this elevator is made by a good company, but it may be either an old type, or of such a type that its motion from low to high speed is not retarded enough, thus allowing a rush of current to blow fuses.

I would suggest, as there is no regular operator on the job, that an oil dashpot be attached to the starting rheostat arm, if possible; or procure a starting speed regulator which includes one. By this means the starting tiller may be pulled to its limit, but the rheostat arm will travel over the contact buttons only as fast as the oil dashpot will permit it to, and it can be regulated to work slow or fast. This simple device will prevent fuses from blowing, or a circuit breaker from opening.

Also, see that the mechanical or electrical brake is tight enough to stop the motor, even when reversed quickly; sometimes there is oil on the brake band, allowing slippage.

I have had exactly the same trouble with an Otis elevator, which already had a dashpot on the controller, but after making proper adjustments all around, it worked satisfactorily.

Jamestown, N. Y. H. S. RICH.

* * * *

Referring to question (1) by L. A. T. in a recent issue, no mention is made of the rating of the fuses used on the equipment. We would suggest checking the size of fuses, as it may be possible that the fuses are not rated high enough. While it is very important not to overfuse the motor, it is well to provide fuses of ample capacity for the service requirements and still give proper protection to the motor. Thirty-ampere fuses could be used for a 10-hp., 550-volt, three-phase, 60-cycle, elevator motor.

If the fuses are rated as above we would suggest checking the general operation of the equipment, including the brake settings, so as to be sure that all details are correct and functioning properly. Buttons on the shipper rope or some other means of centering the reverse switch may help matters considerably.

As to question (2), it is possible to wind a magnet for 110 volts, 60 cycles, that will lift 10 lb. to 25 lb., but it is practically impossible to give any definite winding data to obtain this result, as this depends largely upon the general design and efficiency of the magnet. In the design of an a. c. magnet laminated iron should be used to reduce the eddy currents. The plunger can be designed to have an area of 1 sq. in. for every 8 lb. to 10 lb. pull, while the coil should be approximately 2½ times the length of the stroke and the stop should extend in the coil about ¼ of its length.

There are a number of manufacturers listing a. c. magnets and it may prove a saving to L. A. T. to purchase one of these standard magnets. The Cutler-Hammer Mfg. Co. list a. c. magnets in their catalog under Bull. 10345. The windings used on one of these standard magnets designed for 30-lb. pull at 2-in. stroke on a 110-volt, 60-cycle circuit consists of 180 turns of No. 9 d. c. c. wire. The resistance is 1/3 ohm, and the coil length 4¼ in. For 550 volts, 60 cycles, the coil consists of 900 turns of No. 16 d. c. c. wire, resistance 3.2 ohms.

W. J. NEUSTEDTER.
Engineering Department,
The Cutler-Hammer Mfg. Co.,
Milwaukee, Wis.

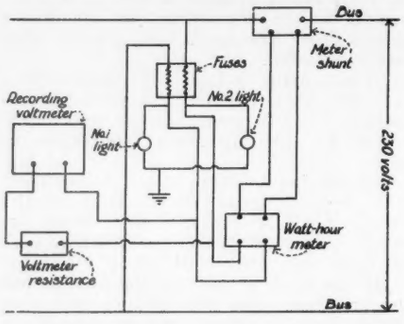
Trouble with Switchboard Instruments—The diagram shows a section of our switchboard with which we are having considerable trouble. The watt-hour meter slows down and the recording voltmeter registers 180 volts when the voltmeter is put in circuit. However, the watt-hour meter runs normally when the recording voltmeter is cut out of circuit. I removed the voltmeter and found it tested O. K., as does the watt-hour meter.

No. 2 light on the ground indicator burns at full brilliancy on account of a ground on the meter circuit, which can not be traced out because the plant operates 24 hrs. a day. No. 1 light does not burn.

When a test light is put across the voltmeter terminals, with the voltmeter cut out of circuit, it burns dimly as does No. 1 light on the ground indicator.

Can someone tell me what and where the trouble is?

Iola, Kan. G. E. G.



In reply to G. E. G. in the December issue, I would like to know whether he tested the voltmeter resistance when he tested the voltmeter. His sketch shows it as external to the instrument and I believe that he will find it the weakest point in that circuit. It is more than likely that his trouble is in the voltmeter circuit, either in the leads to the voltmeter or in the resistance. Very likely it is in the resistance as this is prone to breakdowns from many causes, such as vibration, foreign matter, etc.

A ground in this circuit or resistance could also account for the No. 2 light burning, which would not necessarily affect the wattmeter except that it would record the consumption of more energy than was being used. This extra energy would be that which is lost through the ground circuit.

No. 1 light would not burn in this event because the circuit is completed only through the voltmeter and when so completed the high resistance within and without the meter would not allow enough current to pass to light No. 1 light, for as G. E. G. notes, when the meter is disconnected and a test light placed across its terminals No. 1 ground light burns dimly, due to the fact that not only are the two lights in series, but the external voltmeter resistance and the ground of unknown resistance are also in series.

The voltmeter reading of only 180 volts is due to too high resistance in the circuit, but it is possible to figure the value of this resistance as follows: $230 \div vmr = 180 \div x$, where 230 equals line voltage, vmr equals internal and external voltmeter resistance, and 180 equals indicated voltage. This problem would be an interesting one to work out and the answer may make shutting down the plant a matter of economy.

If I were G. E. G. I should certainly investigate this meter circuit, with particular reference to the resistance.

West Allis, Wis. EDWARD JAMES.

Building Maintenance and Plant Safety

The object of this department is to give details of building maintenance procedure and best practice in safety work. Articles on ways of handling natural wear and tear or other depreciation, repair methods, rebuilding, extensions, cleaning and painting operations will always be welcome.

Charting Frequency of Making Inspections of Equipment

AT the recent annual meeting of the National Safety Council, C. B. Auel, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., in his paper on, "Accident Records, and How to Keep Them," emphasized the need of adequate accident statistics. In this work, he stated, there are four kinds of records which should be considered. These are: (a) Number of Accidents; (b) Accident Frequency; (c) Accident Severity; (d) Causes of Accidents. But little can be accomplished toward the reduction of accidents without knowing what is the cause of them and also how severe are the accidents which are caused by the various hazards.

In addition to these four records, which he considered the absolute minimum which should be maintained in intelligent accident prevention work, Mr. Auel pointed out that there was another set of records which should also be kept if accidents were to be reduced to the minimum. In this, he emphasized particularly a calendar of things to be done regularly in accident prevention work, which consists of a list of safety meeting dates and dates of inspection of various items throughout the plant which must be kept up if accidents are to be avoided. Without having some regular specified time to make these inspections they are frequently overlooked, or the period extended beyond what might be considered a safe time. Such a calendar would include specifically the items shown in the accompanying table.

Inspection Periods for Equipment

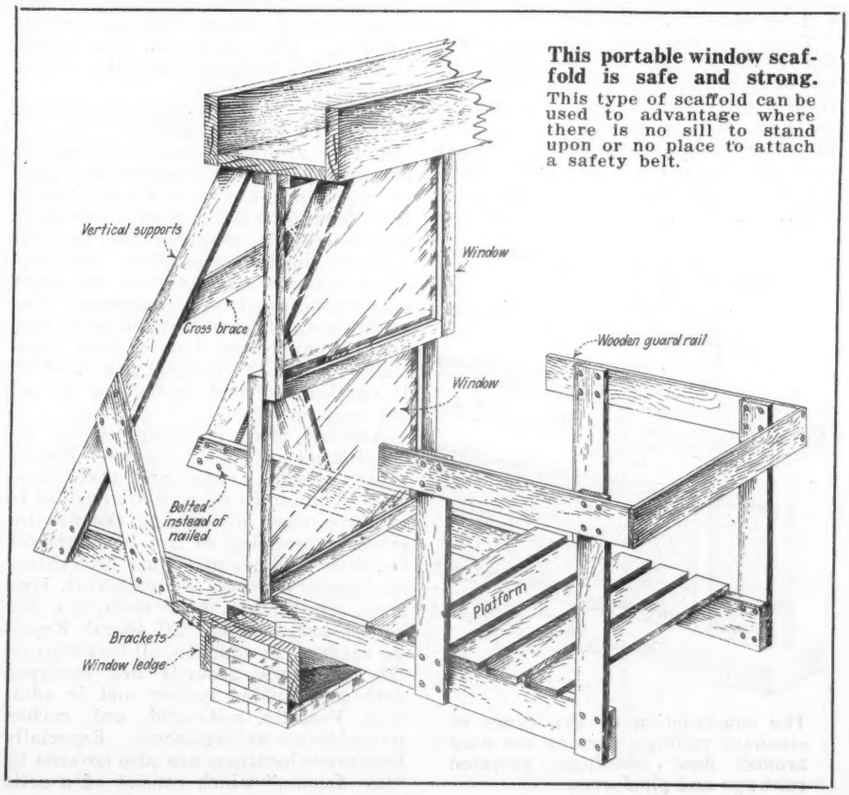
Period	Items
6 mo.	Hand trucks.
6 mo.	Ladders—portable and stationary.
6 mo.	Window cleaners' belts and window eyes.
6 mo.	Stretcher cabinets.
Weekly	First-aid cabinets.
Daily	Cranes, hooks and chairs.
12 mo.	Crane operators } Physical Food handlers } examination.
6 mo.	Hand tools including pneumatic tools.
Daily	Elevators.
12 mo.	Hydraulic elevator trucks.
6 mo.	Electrical hazards.
3 mo.	Machine tool guards.
3 mo.	Safety meetings.

Making a Portable Window Cleaning Scaffold

VARIOUS types of window cleaning and repairing scaffolds are in use, some of which are dangerous while others have a large margin of safety. The construction which is used in one large office building, as is shown in the accompanying sketch, involves sound mechanical principles and is safe. The fixture is detachable and is put up without fasteners or bolts. It is handled entirely from the inside of the building and is lifted through the opening after raising the lower sash. After the window washer has gone outside the bottom sash may be closed.

The platform is fitted with a safety guard rail about 2 ft. high and is constructed entirely of wood, with bolts holding the joints together. The vertical sections sustain the main load and as these are loaded as a column, the danger of breaking is decreased.

Washington, D. C. G. A. LUERS.



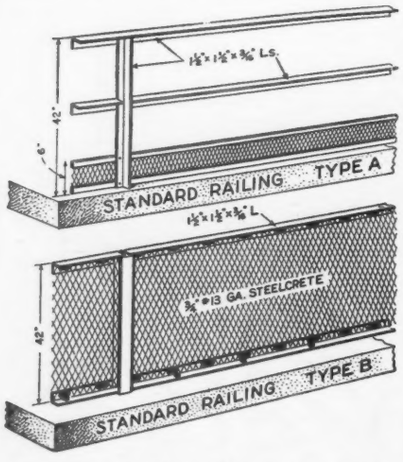
This portable window scaffold is safe and strong. This type of scaffold can be used to advantage where there is no sill to stand upon or no place to attach a safety belt.

Construction Details of Various Standard Railings

IN THE construction of a practical machine guard, strength and conformation with the regulations of the Compensation Insurance or State regulations, should be the primary considerations. State regulations vary somewhat and so should be consulted for each particular location. These regulations govern the distance from the guard to the object guarded, the height of the guard and other similar factors. Strength is important, as a poorly built guard will soon rattle itself to pieces. In any case, a guard should at least be strong enough and rigid enough to stand the weight of a man resting heavily against it. It always pays to construct guards substantially because when this is done the guards will last as long as the machine.

One common type of guard is what is known as the Standard Railing. The construction of two types of standard railings, as recommended by the Consolidated Expanded Metal Company, Braddock, Pa., is shown in the accompanying illustration. Most specifications give a standard railing as 3 ft. 6 in. high, built of 1½-in. by 1½-in. by 3/16-in. angles, with uprights spaced not more than 8 ft. apart. This may be filled with ¾-in., No. 13 gage mesh as at (B), or may be provided with additional railings between the top rail and the floor as at (A). In such a case, a toeboard is necessary. This may be constructed of a strip of sheet metal or of ¾-in., No. 13 gage mesh standing up from the floor to at least a height of 6 in. and run continuously around the edge of galleries, balconies and floor openings to prevent small objects from falling over the edge. These toeboards should be used around all floor openings, elevated runways and platforms, 6 ft. or more from the floor level.

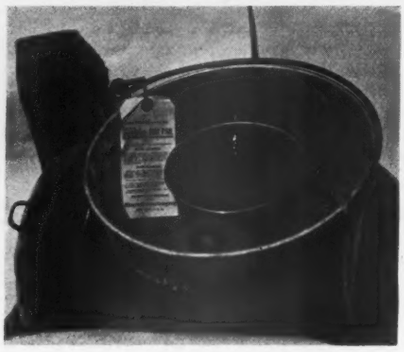
There are, however, some exceptions. For example, they are not needed on small platforms for motors, fans and other similar equipment unless there is an 18-in. width of standing room. Also, they may be left off on oiling runways built only for oiling or repairing shafting, belts and similar equipment if the runway is 18 in. or more in height and has a standard railing on one side. Toeboards are not required on runways used only for giving access to monitor roof windows. Neither is a standard railing required on platforms used for loading freight on cars or trucks.



The construction of two types of standard railings, such as are used around floor openings, elevated runways and platforms.

Organization of Fire Prevention in Industrial Works

EXPERIENCE has shown that practically all fires can be extinguished within three or four minutes if found early enough and if proper equipment is brought into use by men who know how to use it.



The solutions are kept in separate compartments and mix to form a frothy solution which smothers the fire when thrown on it.

Sound fire prevention principles are taught to the men in charge and they are held responsible for the observance of all fire prevention measures by their men. To encourage neatness, monthly plant inspections are made and a banner presented to the most orderly department. The most untidy department is awarded a broom with appropriate wording. This work was first organized in 1917 and put under the control of the safety engineer.

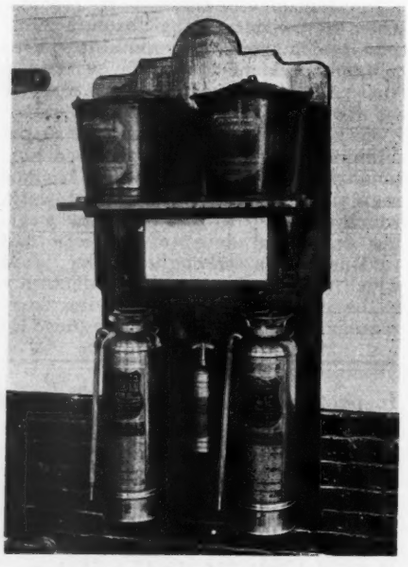
The first piece of equipment received was an "emergency wagon." This carried four 2½-gal. Foamite extinguishers, sand pails, "Y" branches, two shutoff play pipes, 150 ft. of 1½-in. factory hose, 50 ft. of standard hose, two 65-ft. lengths of ½-in. rope, crowbar, axe, two shovels, smoke respirators, gas, hydrant, spanner and monkey wrenches, hose washers and other equipment. This wagon is the first to respond to all fires and is manned by four firemen especially trained in chemical fire fighting. It carries sufficient equipment to put out most fires.

Another piece of equipment is the "equipment wagon," which carries boots, helmets, coats and other supplies. Thus some firemen are enabled to go from work directly to the fire instead of stopping at fire headquarters for their equipment. Other firefighting equipment consists of two 500-ft. hose reels, two 300-ft. hose reels, six fire houses and a Model "D" 40-gal. Foamite engine. In addition, all buildings on the company's grounds are equipped with a sprinkler system and in addition, Foamite, soda-acid, and carbon tetrachloride extinguishers. Especially hazardous locations are also covered by "fire depots," which consist of a solid wood back mounted on the wall with a shelf supporting two Foamite fire pails as shown in the accompanying illustration. A framed set of fire rules is placed between the brackets just underneath the shelf and just below this two Foamite 2½-gal. extinguishers are suspended with a carbon tetrachloride extinguisher between them. While these depots protect extra-hazardous locations, they are placed at a safe distance from the risk so that they will not be involved should a fire occur. The construction of one of these fire pails, which shows how the two solutions are kept separate, is shown in an accompanying illustration.

The location of fire protective devices is carefully pointed out by a system of sheet-metal indicating signs. These have a white background with red lettering reading, "Fire Extinguisher," "Fire Depot." The small end points directly in line with the extinguishing device.

The fire organization consists of a chief, assistant chief, battalion chief, five captains, 23 men, and a fire equipment inspector, who is the only man in uniform. He is responsible to the chief for refilling extinguishers, for care of fire houses, looks after the daily plant inspection, sees to the elimination of inflammable materials, maintains clear aisles, prevents smoking and looks after the enforcement of all fire rules and protection in general. Weekly fire drills keep the members in constant practice. Each member of the fire department is thoroughly trained in artificial resuscitation and in conveying prostrate persons either up or down ladders. One night protection feature lies in the fact that all watchmen are instructed in fire prevention and protection and carry a tetrachloride extinguisher.

K. P. BABCOCK,
Fire Chief and Safety Engineer,
Gilbert & Barker Mfg. Company,
West Springfield, Mass.



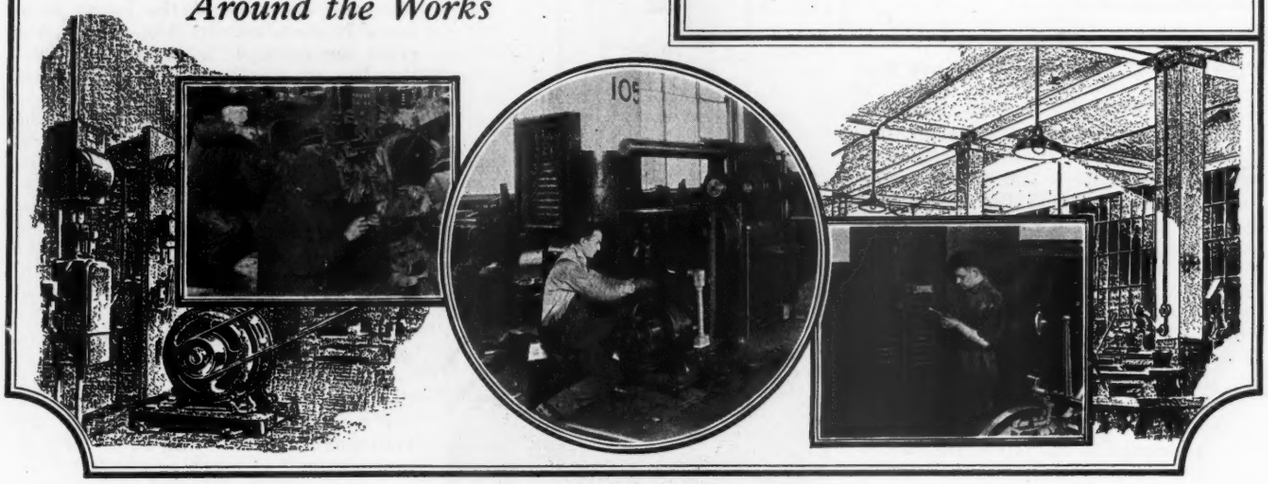
One of the Fire Depots used in hazardous locations.

As an extra precaution several of these Fire Depots are placed near oil containers and other special hazards. These depots consist of a shelf with two fire pails containing Foamite solutions, two 2½-gal. Foamite extinguishers and a carbon tetrachloride extinguisher.

Electrical Service

Around the Works

For this section ideas and practical methods devised to meet particular operating conditions are invited from readers. The items may refer to inspection, overhauling, testing or special installations.



Safety Device for Stopping Crane at Point of Small Clearance

OCCASIONALLY operation of the bridge motion of a crane presents a hazard to workmen repairing equipment which has a small clearance beneath the crane. The crane operator is usually intent on watching the load he is carrying, and mentally maneuvering the spotting of the load, and in consequence cannot be depended upon to observe workmen who might be swept off or crushed against equipment presenting insufficient clearance. Also, the men, intent upon their own work, could hardly be expected to devote their time to watching for the crane.

In one instance a small bucket elevator cleared the bridge girders of a 5-ton crane by about one foot. The drive mechanism was at the top of the elevator, and workmen frequently had to go up there to oil, inspect and repair the mechanism. To minimize the danger as much as possible means were sought to prevent the crane operator from approaching the elevator without receiving some warning when men were working around it.

The crane was equipped with an overhead trolley using a short pole for carrying the harp and wheel. It was decided to put a trolley-type section insulator in one of the trolley wires on each side of the elevator. These insulators were placed far enough from the elevator so that the crane after passing the section insulator, and thus having the power cut off, would almost coast to a stop before reaching the elevator. The feeling of the power being shut off instantly calls the crane operator's attention to the danger zone and he would almost immediately apply the brakes and stop the crane.

The section of trolley wire which was arranged to be made "dead" through the section insulators was supplied with power through a safety switch capable of being locked by individual padlocks which were carried by the mechanics and oilers. The manner of connecting in the safety switch is shown in the accompanying diagram.

Any trolley-sectionalizing device may be used; in this instance, a Westinghouse Type HM, Style No. 127358, insulator was used. Means were provided for fastening it to the lower chord of the roof truss above the crane, as shown in the diagram. The section insulators were placed in the positive trolley wire only, for the circuit was permanently grounded on the negative side as power was also furnished for traction service. The crane rail was not used for a ground return as the sparking on the rails was objectionable and created disturbances on the plant telephone system.

J. ELMER HOUSLEY.
Electrical Engineer,
Aluminum Company of America,
Alcoa, Minn.

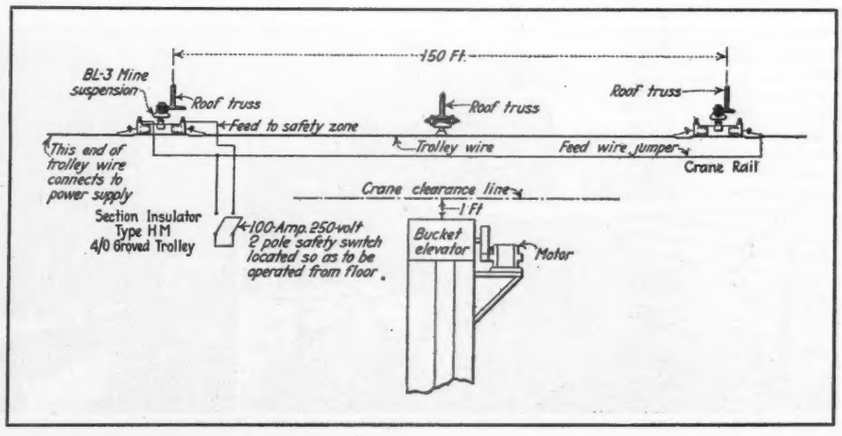
The crane trolley wire adjacent to the elevator was sectionalized by two section insulators.

The sectionalized portion was supplied with power through a safety switch, as shown. When men are working on the elevator the switch is opened; hence power for the crane is shut off as it approaches the elevator, thus preventing injury to men on the elevator.

Trouble Caused by Failure of Test Lamps to Show Open Fuse

IN a paper mill which is driven by two-phase motors, one entire department recently had an unusual experience as the result of a blown fuse. Without warning or other indication of trouble, several motors suddenly stopped while others continued to run. It was found that the motors which had stopped could not be started. An electrician made a hurried test of all branch fuses, using lamps as indicators, and found that all branch fuses tested O. K. The lamp test was then applied to the main feeder fuses and these in turn tested O. K. However, the motors which were running still had a peculiar hum, indicating an open phase.

The foreman accordingly pulled the main feeder fuses and opened them. He found one fuse blown, although the lamps had indicated voltage across all phases. The back-feed or regenerative action of the polyphase motors had caused sufficient voltage to exist across the open phase to light the lamps, although the fuse was open. After this experience, the foreman instructed the electrician to open any suspected fuses or to make sure that no polyphase mo-



tors were connected at the time the lamp test was made. Failure of the lamps to indicate the true condition of the fuses caused a delay of more than an hour in the department affected.

Power Engineer, DEAN W. TAYLOR.
Central Indiana Power Co.,
Indianapolis, Ind.

Portable Compensator Unit for Emergency Use

IN most industrial plants operated by electric motors, it is customary to keep several motors and a few spare compensators on hand for emergency use. By mounting a compensator on a skid platform, as shown in the illustration, and bolting to it a couple of supports for a safety switch, one can with little work assemble a portable unit which can be quickly moved by the aid of a lift truck to any department of the plant.

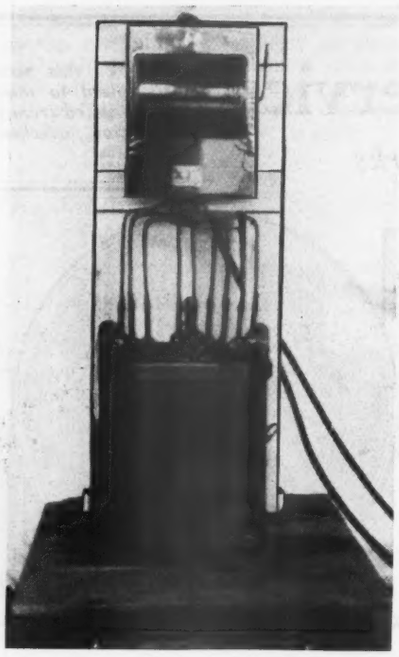
The switch and compensator are connected up after being mounted. The leads connected to the top of the switch and to the motor terminals of the compensator are left long enough to reach any compensator switch when the portable unit is located conveniently close to it. The ends of the six leads (for a three-phase outfit) have terminals soldered on so that in case of a breakdown of the transformer or other part of a compensator requiring more than a few minutes to make repairs, the portable unit can be quickly connected up and put into service.

The switch or line leads of the portable unit are usually connected ahead of the switch blades of the disabled compensator switch, and the motor leads of the unit are connected to the conductors leading to the motor. Thus a motor can be put into operation again in a very few minutes without the trouble and consequent delay of taking down the disabled compensator and installing a new one.

As the disabled compensator is disconnected from the motor circuit repairs can be made on the spot or the compensator can be removed to the repair shop, as the case may require.

Of course, one unit of this kind will not handle all sizes of motors but usually one compensator will operate motors several sizes smaller than its own rating and one unit can thus be used with four or five sizes of motors.

Wearing parts of compensators are kept on hand but occasionally an unexpected breakage occurs and it is found that that particular part is not stocked. A portable compensator unit can then be used until new parts can be obtained, thus avoiding loss of production.



A broken-down compensator can be replaced by this portable compensator-and-switch unit and service restored in a few minutes.

Chief Electrician, J. F. MORGAN.
Mercury Mills, Ltd.,
Hamilton, Can.

Platform for Mounting Electric Welding Equipment

AT the Chicago plant of the Brunswick-Kroeschell Company, three arc-welding sets are used. One of these sets is portable and is moved around the plant, as needed. The other two remain in the welding department where the work is brought to them. Instead of placing the equipment on the floor in the usual manner, the substantial arrangements, shown in the two accompanying illustrations were used.

A steel bench about 3 ft. high was constructed large enough to take all of the equipment for one welding set. The legs and supports of the bench were made from ¼-inch by 2-in. angles, the cross members of ¼-in. steel bar and the top of the bench of ¼-in. steel plate.

The illustration at the left shows the location of the motor-generator set and the cabinet containing the switches for varying the resistance. The illustration at the right shows the location of the push button for starting the set and also the cabinet containing the starting apparatus, as well as the enclosure for the stabilizers, shown at the extreme right. Note the racks on which the electrode cables are wound when the equipment is not in use.

The idea behind the whole installation was to have all parts accessible and convenient for inspection and maintenance and at the same time to protect them as much as possible from the dirt that they would be subjected to if placed directly on the floor.

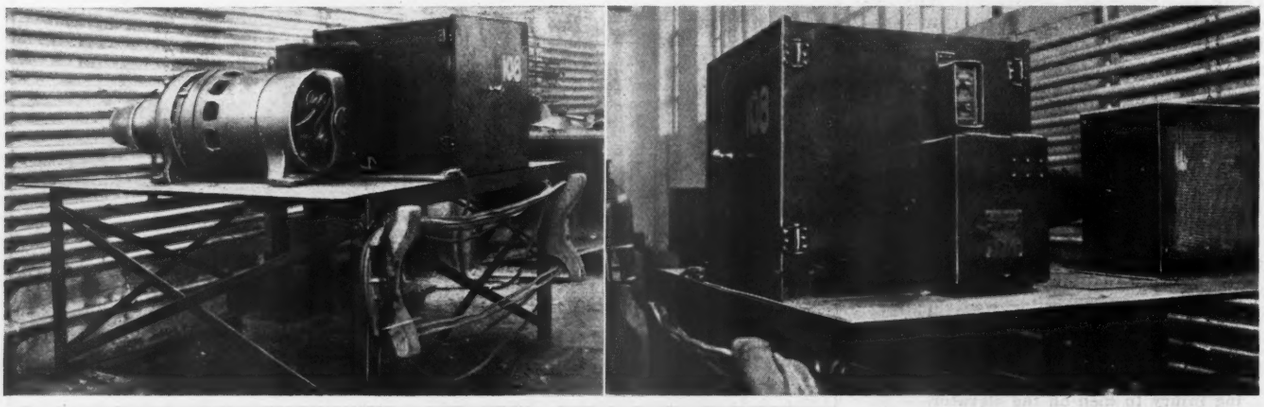
The electric welding equipment mounted on this platform is accessible for inspection and maintenance, and is kept away from the dirt on the floor.

Generator and Storage Battery for Arc Welding

IN A foundry where some of the 200-lb., semi-steel castings come through with a few holes and slight cracks, it was thought advisable to try to arc weld them instead of throwing them back for scrap. As an experiment a No. 00 conductor was clamped to the casting and connected to the positive side of a 100-amp., 110-volt, direct-current switch on a storage battery charging panel. The 3/16th-in. steel welding rod was attached to one end of the negative lead and the other end was connected to the positive post of the panel switch.

This charging panel also carries a current-regulating, gridiron rheostat which was set for 60 amp. when the arc was playing, with the line voltage at 110-volts. However, it was hard to maintain the proper arc at this current value so the rheostat was adjusted to 70, 80 and even 90 amp., but still unsatisfactory results were obtained.

The voltage of the generator was then lowered to 90 volts and the amperes again regulated to 60, 70 and



90 amp., but still the arc would not play steadily and caused a good deal of delay in welding.

A twenty-cell battery of the Edison A-6 type was handy, having been on charge for some hours; so the welding leads were connected to this battery instead of to the generator line. The arc was much easier to maintain, but it was found that the voltage dropped before many minutes. Then we tried using a 50-gal. barrel of water containing sal soda and sal ammoniac with two iron plates for electrodes and connected in the generator line on 110 volts. This arrangement worked fairly well, but the arc was still unruly.

Finally, the leads were connected again to the storage battery which was floated on the generator line at 110 volts, and with the rheostat set at only 70 amp. the arc now holds remarkably steady. Once in a while the negative rod "freezes" to the casting and immediately gets red hot right up to the operator's holding pliers. The meter meanwhile registers not over 90 amp.

With this final arrangement, scores of large castings are being welded every week. The operator protects his face and eyes by ruby- and violet-colored glass, mounted in a light wooden frame held in one hand. This allows him to glance quickly at the flaw in the casting after it has been welded, as it is impossible to see some of the holes and cracks by looking through the shield.

A canvas glove is used on the right hand as the steel welding rod and pliers get very hot at times. Spare rods are kept handy and can be quickly bolted to the lead.

The conductors are attached to the battery terminals by large copper lugs which are slotted for quick handling. Copper lugs are also used at the other end, one at the clamp which is fastened to the casting and one at the welding rod. One end of the rod is bent in a small loop so that it can be bolted to the lug.

The battery terminals are quite large and are located at the ends of the containing cases or trays so that it is easy to connect copper lugs to them. Leads 12 ft. long are used so as to get at a safe distance from the battery, which gases fiercely when on overcharge. The gas given off is easily exploded by a stray spark, as we have learned by experience.

Besides castings, many other things such as tools and broken machine parts can be quickly welded, as it is easy to get the welding rod into any corner or any other out-of-the-way place.

This outfit is not used steadily; so the battery can, without difficulty, be kept charged. The results obtained by welding have been so satisfactory that it is planned to install a standard portable welding outfit in the near future. However, the arrangement described above has served its purpose well.

New Britain, Conn. H. S. RICH.

Safety Device For Killing Live Trolley Wire When It Breaks

MANY cranes use collector or trolley wires for the power supply to the bridge and trolley motors instead of the bars or angles which are now more widely used. Trouble is sometime experienced with the trolley wire breaking and the live ends coming in contact with workmen or material, thus grounding the wires and possibly causing some damage or injury. The purpose of the device described in this article is to kill the power supply on a trolley wire as soon as it breaks.

The device is located at the end of the trolley wire at which power is delivered. A ball insulator and turnbuckle are fastened to the eyebolt (A) and to the trolley-wire support. The trolley wire is fastened to eyebolt (B) and tension is applied to the trolley wire so as to compress the spring to the position shown in the drawing. This brings the copper block (C) in contact with the flat-iron strips forming the sides of the device. The power supply is connected to the terminal screws (E).

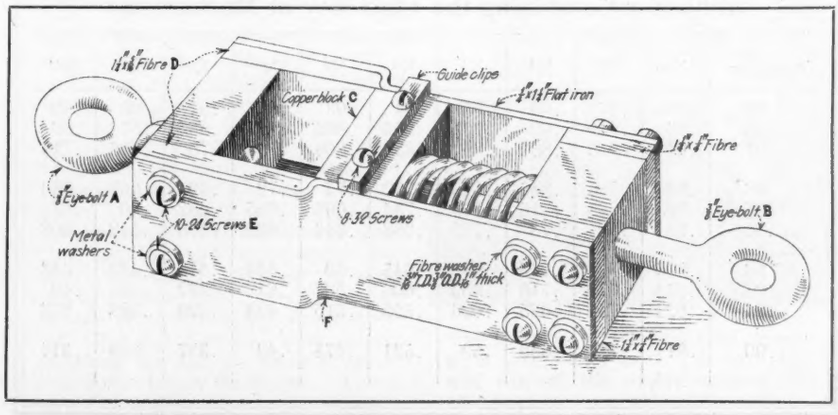
With tension on the trolley wire so that the spring is compressed, the current will flow from the line to the terminals through screws (E) through the flat-iron sides to copper block (C), through eyebolt (B) to trolley wire. If the trolley wire breaks the compression spring will force the copper block (C) towards the eyebolt (A) and the copper block will be insulated from the flat-iron sides by the fibre strips (D). Hence the trolley wire is dead and there will be no danger of electric shocks from touching it.

The device can be readily made from material at hand in any electrical repair shop. The accompanying drawing gives the details of the material to be used. In making up the device it is important that the separator, through which the eyebolt (B) passes and to which the flat-iron sides are bolted, be insulated by the two fibre blocks, as shown in the drawing.

The separator which holds the eyebolt (A) need not be insulated, but if it is, it does away with the need of a strain ball insulator, for the eyebolt (A) would then be insulated and could be attached directly to the support. In case the separator which holds the eyebolt (A) is not insulated, it will be necessary to place a fibre block so as to prevent the copper block (C) from striking this eyebolt and its separator; otherwise contact would be made between the block (C) and the line, after the trolley wire had broken. This fibre insulator may be fastened to the copper block (C) or to the separator which carries eyebolt (A).

Detroit, Mich. O. E. BRICKER.

This device is a good safety feature for cranes using trolley wires. Power is applied at *E* and travels through the metal sides of the device to the copper block *C*, thence to eyebolt *B*, to which is fastened the trolley wire. If the trolley wire should break the tension on it would be released and the spring in the device would force the copper block *C* towards eyebolt *A*, and block *C* would be insulated from the metal sides by the fibre strips *D*. Hence both ends of the broken trolley wire would be dead.

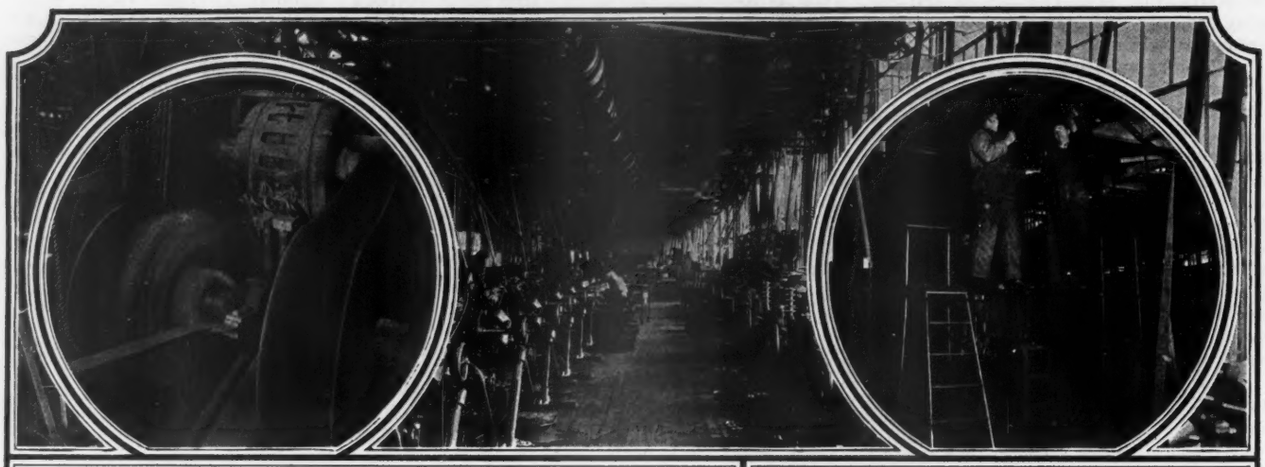


Advantageous Applications of Two-Speed Motors

IN MANY industrial plants there are motor applications that call for more than one motor speed. Where the duty of the motor is more or less continuous, the merits of the two-speed, squirrel-cage motor may well be considered in comparison with those of the variable-speed, slip-ring motor. A common application of this class of motors is in driving ventilating fans. Often it is felt that very sensitive control is required for fan motors, but in many cases the chief requirement is the ability to operate efficiently under heavy or day duty and light or night duty. In many such instances the light-duty speed does not have to be any particular value and does not need to be as great as for regular, heavy duty. Under these circumstances the two-speed, squirrel-cage motor excels the slip-ring motor.

At half-speed the two-speed motor has practically the same efficiency as at full speed, while the slip-ring motor efficiency at half-speed is generally less than half the full-speed efficiency. It follows that where half-speed is sufficient for the duty required, the two-speed motor will be more than twice as efficient as the slip-ring motor. Very often the period of light duty is longer than the period of heavy duty. In this case the superiority of the two-speed motor is of still greater importance. In addition to its greater efficiency over its speed range, the two-speed motor will generally be cheaper to install and less expensive to maintain than will the slip-ring motor.

Power Engineer, DEAN W. TAYLOR.
Central Indiana Power Co.,
Indianapolis, Ind.



Mechanical Maintenance of Power Drives

This department will furnish mechanical details of installation, operation and maintenance of equipment in the path of power service from the first mechanical driving element through transmitting equipment to all driven machines.

Determining Combined Efficiency of Elements of Hoisting Mechanisms

WHEN designing hoisting machinery for handling heavy weights at low speeds, it may be necessary to use several gear reductions and 12 or more parts of cable. If the slide rule is employed to calculate the efficiency of this mechanism there is considerable danger of error in multiplying the same number several times; therefore, in order to save time and reduce the number of errors, the writer has made up and uses the accompanying table, which has been found very convenient. This table was calculated on the slide rule, as this gives results which are sufficiently accurate for the purpose.

The following example will illustrate the method of using the table: What is the over-all efficiency of a headgate hoist with 4 reductions of gearing and 12 parts of cable, assuming an efficiency of 0.94 for each gear reduction and 0.98 for each pair of sheaves? From the table the fourth power of 0.94 equals 0.78 and the sixth power of 0.98 equals 0.885; therefore, $0.78 \times 0.885 = 0.69$, which is the combined efficiency of the mechanism.

Montreal, Can. WM. L. LAING.

Method of Securing Co-operation of Operators When Making Speed Changes

IN these days, everything industrial is being speeded up. Machine operators sometimes kick about this and try to find weak spots in the results. But every department head who reads his engineering paper, who goes around a bit, who listens as he should to the salesmen who drop in—every such person knows that new machinery that will run faster should be put in, or the existing machinery speeded up. The latter is the easier and less expensive method, but it runs up against that adverse personal element more than does the former. How shall it be brought about in the most effective way? This problem is of importance to executives, industrial engineers, mechanics, millwrights, and foremen.

One hustling machine shop has been through all of this. It has made money. The same machines are running twice as fast as they were ten years ago. The men seem to be used to the change and they are getting out a proportionate amount of work. There are 80 machine tools in this shop, kept in good condition, and the shop is meeting competition in a manufacturing line even though there is little capital available for new machines. The way it has been worked is applicable to other plants and is worthy of detailed consideration.

There were several metal planers in the shop. In the days when Joshua Rose's "Complete Practical Machinist" was the one book of the trade, a cutting speed of 15 ft. or 18 ft. per minute was considered proper for planing. This shop's planers were belted to that standard. The shop's new executive had the lineshaft pulleys changed to bring these up to 20 and 22 f.p.m. The men got along all right, in fact, rather enjoyed the change, for there is a lot of tedious waiting in doing planer work.

A year later, a change in motor pulleys jacked this speed up another 5 ft. a minute. With the changes which time works in the personnel of a shop new men were taught to run planers, and along with this the superintendent took occasion to still further increase the speed, until today the planers are running at 40 f.p.m. and all concerned take that speed for granted. Once, during the stepping-up process of later days, there was a concerted complaint of the machines running too fast to properly watch the tool, whereupon the men were taken to a motor truck factory in the same city and given a peep at a planer running on aluminum crank cases at 75 f.p.m.; needless to say they came back satisfied.

In drilling, much the same plan of gradually increasing the speed was followed out. It is always easier to get men to remember that, for instance, a ½-in. drill should be run on the third step of the pulley than to remember it is to cut at 80 ft. a minute. The tendency is to err on the slow side of this rather than on the fast, and by changing the main shaft pulleys the actual speed for each step of the cones was increased just that much. Today, 1-in.

Table for Combining the Efficiency of Mechanisms

Number	N^2	N^3	N^4	N^5	N^6	N^7	N^8	N^9	N^{10}	N^{11}
.99	.98	.97	.96	.95	.94	.93	.92	.91	.90	.89
.98	.96	.94	.92	.905	.885	.866	.85	.833	.815	.80
.97	.94	.913	.884	.86	.833	.806	.783	.76	.736	.715
.96	.92	.885	.846	.815	.782	.75	.72	.691	.663	.636
.95	.903	.856	.815	.773	.736	.698	.665	.632	.60	.57
.94	.884	.83	.78	.732	.688	.646	.608	.576	.542	.508
.93	.865	.804	.748	.695	.645	.60	.558	.518	.482	.448
.92	.846	.779	.716	.659	.606	.567	.513	.472	.435	.40
.91	.828	.754	.685	.623	.566	.515	.468	.426	.388	.353
.90	.81	.729	.656	.59	.531	.478	.43	.387	.348	.314

drills are being run as fast as ½-in. drills were five years ago.

On manufacturing work that uses drills smaller than ½ in. the change to high-speed drills was made long ago, but under the former management the machines had remained at the same belted speed and the benefits, some of them, from the superior steel, were realized only if the speed change on the machine itself was shifted to its fastest speed. Usually it was not. The new regime put on pulleys that were too fast for high-speed steel, with the result that on the lower speeds, where the boys were likely to run them, the speed was just about correct. Not long ago a battery of six milling machines came in for attention. Whereas a decade ago they were running at a spindle speed of 100 r.p.m., they are now doing from 220 to 280. In speeding up these milling machines, all the work was done out of hours—usually over the week end—and so the operators knew nothing of it. These were single-speed, single-purpose machines and the work was of such a nature that a straight count of the number of pieces done per day did not tell the men anything about their output; the men were day workers, and quality was stressed more than anything else.

In this way, greater output was secured without friction in the shop. Had the men seen the changes in pulleys and belts, they would have inwardly rebelled. As it was, one machine at a time was changed over and no one was the wiser. The results secured went a long way toward meeting the increased costs of doing business, including higher costs for materials and wages, and the like.

This same shop made its own tools and jigs and one of the machine tools employed on this work was a 16-in. shaper. All the men who had used this machine "found" that a one-tooth feed was the highest permissible for good work. There were five feed changes on the machine, made by shifting an eccentric and dropping a spring pin in any one of five holes. One night the foreman plugged the first hole and now they get along just as well and do as perfect work with a two-tooth feed as before with the one.

What has been done in this machine shop can be done in others and can be done in other lines, whether it is the cement business or textiles or printing. The main thing is to read the trade papers and the best books and learn from them what advances others are making—then try them for yourself, in your own way on your own particular machinery. Old machinery can be speeded up remarkably high. The writer is not one of those who believes that "they don't make as good equipments now as they used to," but he believes that where you can't get new machinery you certainly can get more out of the old.

The co-operation of the men running machines is necessary in any plan of greater production. Oftentimes, a good deal of coaxing and explanation and driving is necessary. Where the work is not physically hard, men on a day wage are seldom putting forth their highest efforts and so a certain amount of speeding up can be done honestly without going into a discussion. An instance of this fact was noted recently in a wood-working plant. Thirteen men had been kept busy making window blinds and they were always behind the rest of the mill work. A change to piece work was made and now one man and a boy take care of all requirements nicely.

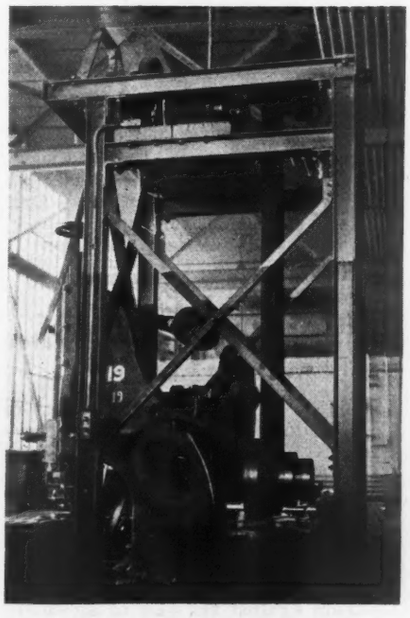
As has already been said, the best time to change speeds is over night or during week ends. Do all the work, including placing the belts on the pulleys and picking up odds and ends; better still, start up the power and run a trial piece or two. If the plant is shut down for a week, that is a good time to re-speed machines or departments, the latter being done by installing larger motor pulleys. DONALD A. HAMPSON.
Plant Superintendent,
Morgans and Wilcox Mfg. Co.,
Middletown, N. Y.

Taking Advantage of Belt Slip As Safety Link in Machine Drives

SOMETIMES industrial men complain because belts slip. However, if belts are of the correct tension and capacity for the load and overload conditions, slip is not a serious factor. Under some service conditions the ability of the belt to slip under special conditions, is a distinct advantage. For example, in the slotter drive shown in an accompanying illustration, the belt slips and finally runs off the cone pulleys when the slotter sticks because of an extra heavy feed or other cause.

Originally, the motor was connected to this slotter by chain. A few days later, the operator accidentally brought the ram down on the piece and something had to break. The countershaft and cone pulleys were then added and give adjustable speed in addition to a safety link against a similar mishap.

When machines, such as this which operate under conditions where they may be stopped suddenly or be heavily overloaded, are to be driven by chains it is almost necessary to insert a safety pin in the sprocket which will break when the load is applied but before endangering the sprocket or chain.



The belt driving this slotter serves as a safety link in that it will slip and run off the pulley in case of stoppage or an overload.

Chicago, Ill. E. D. F.

Operating Heavy-Duty Lineshafts On Ball Bearings

FREQUENTLY service conditions on lineshaft hanger bearings are so severe that considerable difficulty is experienced with ordinary bearings. Such a case occurred in the main lineshaft drive at the plant of C. V. Hill & Co., Inc., Trenton, N. J., manufacturers of refrigerators and store fixtures. As this is a woodworking plant the machinery and lineshaft are operated at a speed which is higher than the average for most industries. The 3 7/16-in. shaft is driven at 330 r.p.m. by a 24-in. double belt from a 150-hp. engine.

The most severe conditions here are due to the fact that the shaft is mounted on a brick wall on bracket hangers and adjustable, self-aligning hanger boxes. The wall does not have any strengthening supports and bulges during operation due to the high tension maintained on the belt. This throws the shaft entirely out of alignment.

After considerable trouble with other bearings, Fafnir double-ball, self-aligning transmission bearings and hangers were installed. Where previously the oiling had required careful and frequent attention the new bearings received only two oilings in 18 mo.

Narberth, Pa. STANLEY D. BERG.

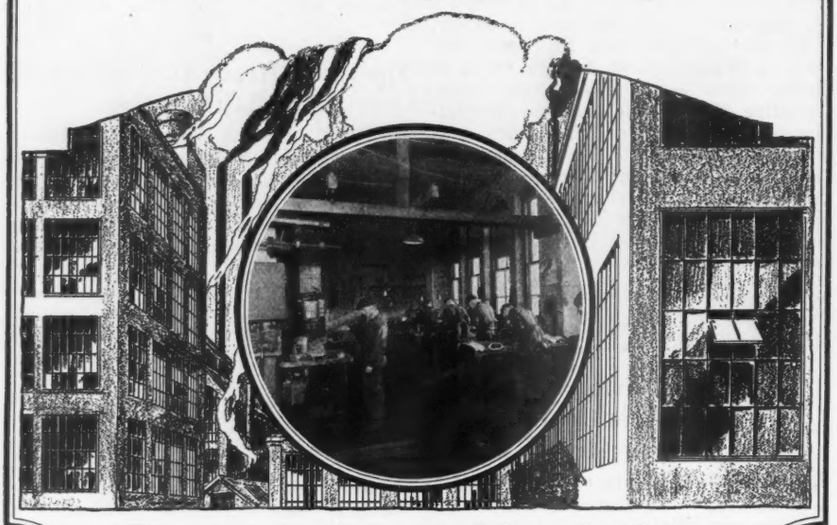
Static Electricity Cause of Shocks to Oilers

RECENTLY I was called upon to trace the cause of shocks which the oilers received when they worked around an automatic bottle machine. I tested from the machine to ground for defects, thinking that perhaps one of the seven motors on the oiling system on the machine was defective. This investigation failed to disclose any defects; so I decided to watch one of the men while he was oiling different parts of the machine. I found that he reached through a blast of steam coming out of a ¼-in. nozzle at 60 lb. pressure, which is used for cooling certain parts of the machine. I found that it was while reaching through the blast of steam that he received a shock.

To test out my theory that static electricity was the cause of the shock, I attached a wire to an oil can and tied the latter to a dry stick. The end of the wire was held a short distance from part of the metal work of the machine, to form a spark gap to ground. When I held the oil can in the steam blast there was a continuous rain of sparks, caused by the static electricity generated by the steam blast on the oil can.

After the oilers were instructed to turn off the steam while oiling the machine, no further trouble was experienced. L. E. BENEZE.
Chief Electrician,
Illinois Glass Company,
Alton, Ill.

In the Repair Shop



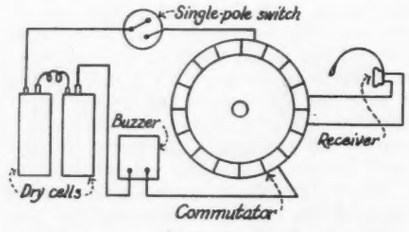
This section is devoted to repair work, large and small. Special attention is given to shop or bench tools and short cuts or improved methods. Contributions are always welcome.

Inexpensive Outfit for Locating Defects in Armatures

FOR testing armatures we use in our shop an outfit that is quite efficient and very cheap to make. It consists of two dry cells, an ordinary buzzer and a telephone receiver. For the sake of protection and convenience in handling, the batteries and buzzer are enclosed in a box. Two leads each about 3 ft. long are brought out from the box and as will be seen from the illustration a single-pole switch is cut into one of the leads so that the circuit may be broken as desired, or when the outfit is not in use. The insulation is skinned off for about an inch at the ends of the leads, which are fastened to a piece of strong cord.

In use, the cord is tied around the commutator to be tested and the points separated about 10 or 20 bars, depending on the resistance of the coils and the number of bars in the commutator. The leads of the telephone receiver are then placed on adjoining bars between the points and the character and intensity of the buzzing sound is noted in the receiver. Each pair of bars between the buzzer points is then tested in succession.

If all the bars sound alike, the armature can safely be relied upon to run.



Method of using a buzzer and a telephone receiver for testing armatures.

If a low sound, or no sound at all, is obtained, a short-circuit is indicated. A sound which is louder than usual indicates an open circuit between the two bars. A crossed or transposed lead will sound like a shorted coil: that is, it will give either a low buzz or no buzz at all. A grounded coil can be located by putting one of the receiver leads on the shaft and then moving the other from bar to bar and noting where the sound is lowest. The bar that has the lowest sound is usually connected to the grounded coil.

A shorted or grounded coil in a stator can be located with a buzzer by touching the ends of the buzzer leads to the leads on the stator and then testing the individual coils in the same manner as the bars on the commutator.

We find this method of testing to be about as accurate as the use of a millivoltmeter or other testing instruments; at the same time, it is generally easier and quicker than most other methods. This outfit has the further advantage that it is light and easy to carry and, therefore, convenient for outside jobs.

Peoria, Ill. GEORGE E. RINGNESS.

Emergency Method of Thinning Commutator Slotting Cutters

COMMUTATOR slotting cutters used in a certain repair shop were of two different thicknesses 0.025-in. and 0.040-in. respectively. The supply of 0.025-in. cutters became unexpectedly exhausted and the prospects indicated serious delay in production before any more could be obtained. A few of the 0.040-in. cutters were thinned by holding them against the side of an emery wheel with a pair of pliers, but the results were very unsatisfactory because the teeth varied in thickness in different places around the circumference of the cutters. Eventually another emergency grinding method was adopted.

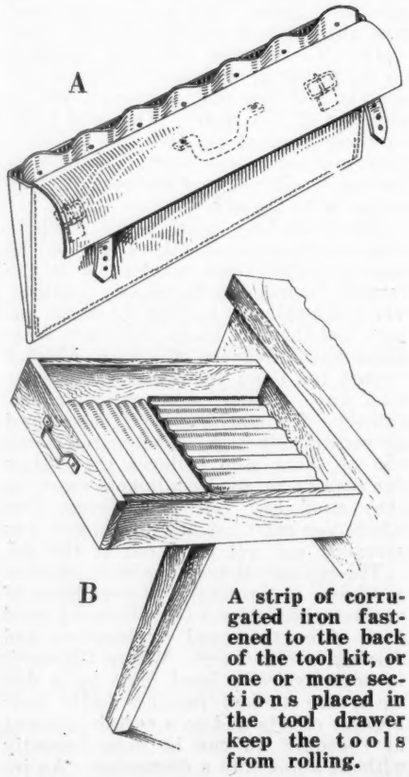
A piece of hardwood rod, such as is used for making dowel pins in the pattern shop, was obtained. The cutter was slipped over the end of the rod and the latter pressed against the side of an emery wheel with the left hand; by means of a wooden stick in the right hand, the cutter was also pressed against the wheel. By trial a point of application of the stick to the cutter was found where the cutter could be made to revolve slowly and thereby continuously present a new surface to the emery wheel. At first, unconscious relaxation of hand pressure on the wooden rod frequently would permit the cutter to fly off the rod into the catch pan under the wheel, but a little practice overcame this.

It took about three minutes to reduce an 0.040-in. cutter to a fairly uniform thickness of 0.025-in. and in thinning 12 cutters it was necessary to use about 9 in. of the wooden dowel rod.

Brooklyn, N. Y. J. A. HORTON.

Corrugated Iron Used to Keep Tools in Order

SIMPLE and convenient means of keeping small tools arranged in an orderly manner and easy of access will usually save their cost many times over. Small strips of corrugated galvanized iron can be used for this purpose in several different ways, at little or no cost. For example, a strip of any convenient length may be nailed or screwed to the wall above the bench and a variety of small tools slipped into the pockets formed by the corrugations. With this arrangement, it is a simple matter to keep the bench from being littered with



A strip of corrugated iron fastened to the back of the tool kit, or one or more sections placed in the tool drawer keep the tools from rolling.

tools, and yet these are always within sight and easy reach. If a narrow strip of wood is nailed close to and underneath the corrugated iron, drills and the like may be kept in the pockets.

Again, a very handy tool kit may be made from heavy canvas with a strip of corrugated iron fastened inside at the back, as is shown in (A) of the illustration. In this case also, screwdrivers, chucks, drills and so on may be placed in the corrugations and thus kept separate but easily located. In use the kit is tipped slightly and the tools slide forward, making the selection of the desired tools easy.

A third use of corrugated iron is in the bottom of tool drawers, as shown in (B). Two sections placed in the bottom of the drawer are most convenient. A piece for long tools, placed lengthwise of the drawer at the rear, and a crosspiece in the forward section for small tools, will be found very convenient in keeping the tools in orderly arrangement, as they will be prevented from rolling from one end of the drawer to the other or from side to side when the drawer is opened or closed.

Washington, D. C. G. A. LUERS.

Essential Construction Details of A. C. Magnets

CONSTRUCTING a good a. c. magnet is a problem that seems to puzzle many mechanics and engineers. A good deal has been written about magnets, but it is rather strange that books often give page after page of details about pull, number of turns, size of wire and the like, without mentioning the far more important mechanical requirements for making a good a. c. magnet.

In constructing such a magnet, the first and by far the most important thing is to get the mechanical parts right and the rest can be worked out with a little experimenting, if the right size of wire or the right number of turns cannot be figured correctly the first time. If the magnetic circuit or mechanical construction is wrong the magnet will remain wrong no matter how many coils are tried on it to make it quiet or operate satisfactorily.

The horseshoe-type magnet is by far the most common. In this type of magnet the armature is generally hinged so that the effective pull is nearly all on one leg of the magnet. A typical magnet of this kind is shown in (A) of the illustration. The core of the magnet as well as the armature is made up of sheet-iron punchings or laminations to keep down the eddy current or core loss. As the current reverses in all a. c. magnets the magnetism must also reverse and if there were no other means for holding the magnet closed during the reversal the magnet would start to open up and then close again as the magnetism built up again in the opposite direction. As this reversal of magnetism takes place 120 times a second on a 60-cycle circuit, the periods when there is no pull are so short that the magnet could not really open much, but a very disturbing noise will be produced. To overcome this noise or humming the surface of the active pole (the pole farthest away from the hinge) is given as perfect a fit as is possible with the armature, generally by grinding but quite often by scraping after the grinding. Where the magnetism crosses this joint some form of a shading ring which can be in the form of rivets, a copper, brass or iron ring or a wound coil, depending upon the size of the magnet, is placed as near the surface as possible in either the armature of leg of the magnet so as to cover at least half of the pole area. The function of this coil or ring is to make the magnetism that passes through the coils lag behind the magnetism that goes past the coil in such a way that when the magnetism that passes the coil reverses that passing through the coil is still continuing due to the current induced in the coil. As this magnetism dies down within the section of the pole covered by the shading coil it also changes from passing around the entire magnet to forming a local circuit or small whirlpool as shown in the illustration and holds the armature down long enough for the magnetism in the rest of the circuit to build up in the opposite direction until it is strong enough to hold the armature down. There is, therefore, a constant magnetic pull greater than that required to keep the magnet closed.

If the electric circuit is broken just before the current reverses, there will be enough residual magnetism left to make such a magnet stick badly, even though it is built of soft iron or steel punchings, if the proper air gap is not provided somewhere in the magnetic circuit. This air gap is nearly always placed between the armature and the leg of the magnet nearest the hinge. This gap need not be over 0.005 in. to kill practically all the residual magnetism but it is generally two or three times that amount to insure against wear. It is very important that this air gap be not bridged by any iron hinge or other iron mounting. Therefore, the hinge should be made of nonmagnetic material such as brass. It might be mentioned here that the short magnetic lines set up around the shading coil during the reversal of current have no noticeable sticking effect. Where rivets are used to hold the punchings together, as is generally done, they must be so placed that none of them form a closed circuit with any of the rest through which current can be induced. That is, all the magnetic lines of force that pass on the inside of one rivet must also pass on the inside of all the rest, unless the rivets are insulated, which is seldom necessary. For that reason, rivets in both armature and horseshoe parts are all placed along the center line as indicated in the figure. However, they should all be placed at the outer edge or all near the inner edge, but never staggered nor in a double row, or some of them would have to be insulated.

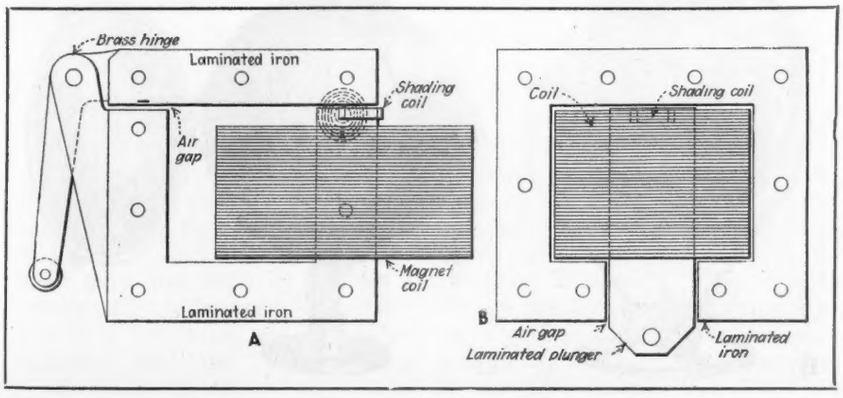
The hinge of such magnets should be well fitted and rugged. In many cases the laminations of both parts are riveted to a heavy center piece of brass that also forms the hinge while in cheaper magnets it is a heavy sheet steel punching with a brass bushing. Side plates are not quite as desirable from the electrical standpoint as the center mounting but may be a little easier to construct.

Unlike d. c. magnets, resistance tubes should not be used in any a. c. magnet that requires energy to close because when the magnet is open the impedance is low and any resistance that would materially reduce the voltage on the magnet when it is closed would practically absorb all the voltage that the magnet would get when it was open and, therefore, there would be no pull on the armature. The closing power, especially in the plunger type of magnet, is entirely different in an a. c. magnet from what it is in a d. c. magnet. With an a. c. magnet it is much greater when the magnet is open than in the case of a d. c. magnet. while it is less when the magnet is closed. This is due to the much heavier wire used in the a. c. magnet, which allows it to take a very heavy current while open, the current decreasing rapidly as the magnet closes, due to the higher impedance. The current in a d. c. magnet coil, on the other hand. depends entirely on the resistance and is the same when the magnet is open as when it is closed, while the magnetism increases from a very weak field when the magnet is open to a very strong field when the magnet is closed. The pulling power is, therefore, low until the magnet is very nearly closed.

In (B) of the illustration is shown a typical a. c. plunger magnet, the shading coil being in the top of the plunger, which is grounded, as is the inside upper part of the magnet frame. An air gap is provided where the plunger is guided on the edges of brass plates as it passes through the lower part of the magnet.

PHILIP G. BERNHOLZ.

East Orange, N. J.



Details of horseshoe type, A, and plunger type, B, a. c. magnets.

Electrical Devices in Power Service

(*Continued from page 83*)

made. The object in making a new design was to obtain a lighter and more easily handled piece of apparatus. The advantages of the new outfit over the old one are that it is considerably lighter, and more convenient to handle.

Meters and Relays.—Rectangular-shaped, switchboard meters have been placed on the market by the Weston Electrical Instrument Company of Newark, N. J. This company informs us that this type of meter as compared to the old round-pattern type results in a space saving in the ratio of five to nine.

The Roller-Smith Company of New York, N. Y., informs us that it has brought out three new lines of switchboard meters, some intended for use on direct current and others for alternating current. This company has also developed a new portable, alternating-current, ammeter and voltmeter, which it has added to its extensive line of meters.

Clock improvements on its line of graphic meters are reported by the Esterline-Angus Company of Indianapolis, Ind. Some of the intermediate gears in the driving mechanism have been eliminated thereby reducing lost motion and friction. The company further states that in order to make the works of the clock more accessible for inspection and cleaning, the metal cover which fits between the side plates is now made removable, so that by sliding this plate out, the entire train is exposed and accessible for any oiling or maintenance that might be required.

A type NT amperehour meter has recently been placed on the market by the Sangamo Electric Company of Springfield, Ill., which is designed for use on electric automobiles, trucks, mine locomotives, industrial tractors, and the like, where severe conditions of operation are likely to be encountered. Installed on the vehicle, truck or locomotive, the meter indicates by means of a black hand the amount of battery discharge that has taken place. By comparing the position of this hand with a red hand located at the point where the battery should be recharged, the operator can tell what remaining capacity is available before the battery should be put on charge. This guards the vehicle from being stalled when at a distance from a battery recharging station.

When the vehicle is placed on charge the Sangamo amperehour meter automatically gives the battery the proper overcharge and opens the charging circuit at the proper time, thus eliminating the need for attendance.

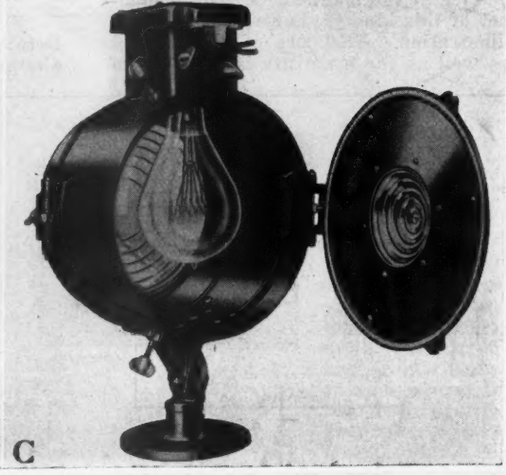
A maximum demand regulator for reducing peaks and power demands on electric systems has been developed and placed on the market by Edward T. Moore, electrical engineer, Syracuse, N. Y. The regulator is designed to limit the amount of power taken by any energy-consuming device and is especially intended for use with large loads such as electric steel-melting furnaces, annealing and heat-treating furnaces and pulp-wood grinders, as well as motors and other equipment. It is said that the regulator may be set to limit any power load to a predetermined amount, may be used for any length of demand period and may be changed as desired. A graphic meter or integrating meter may also be used in connection with the regulator.

Miscellaneous.—In congested installations it is often difficult to install the usual type of disconnects equipped with mounting base. To meet this condition a bus type of switch designed to clamp directly to the bus bar, has been developed by the Delta-Star Electric Company, Chicago, Ill. Blades can be set in line with, at right angles to the bus, or in any intermediate position that may be needed to fit the installation requirements.

Bus spacers are desirable when buses are so installed that short circuits will subject the bus bar to a cantilever pull. The tensile and compression strength of bus supports are greater than the cantilever strength but by installing bus spacers the cantilever pull on the supports will be practically neutralized. A new type of bus spacer has been designed by the Delta-Star Electric Company, Chicago, Ill.

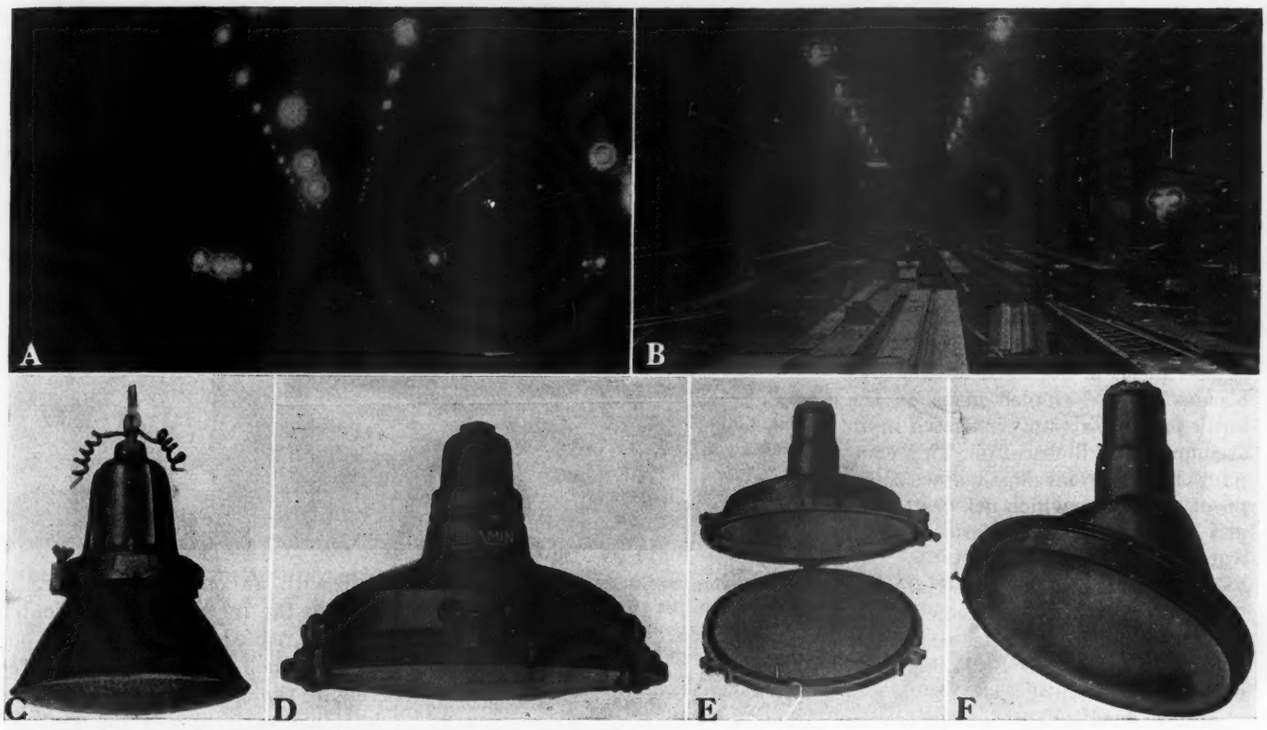
A new bus support has been designed by this company for supporting bars of high ampere-capacity. It is said to have an ultimate strength of 60,000 lb. against short circuits between phases. With this support the phase conductors are separated into two parallel sets of bars, reducing induction and heat and increasing the ampere-carrying capacity per square inch over that secured with the conventional ¼-in. spacing between bars.

An inclosed primary disconnecting switch for use in vaults ahead of the oil circuit breakers on circuits of 4,400 volts and under in capacities from 100 amp. to 400 amp. has been placed on the market by the Line Material Company, Milwaukee, Wis.



Well lighted yards not only increase the amount of work done but are also safer for workmen.

At *B* is shown a floodlight projector made by the General Electric Company. At *C* is one made by the Crouse-Hinds Company of Syracuse, N. Y. Both have been especially developed for the dirty, dusty service of steel mill and railroad yards. At *A* is shown a signal light made by the Nichols-Lintern Company of Cleveland, Ohio. It is made of aluminum and said to be able to stand severe outdoor and indoor service.



Industrial reflectors that have been developed to cope with the dirt and smoke found in many industrial plants.

At *A* and *B* are shown views "before and after installation" of the High Mounting Height Units made by the Holophane Glass Company, Inc., of New York, N. Y. It is pointed out that these units are particularly adapted for use when the lighting units must be installed at a considerable height, as over a crane runway. *C* is a new dustproof reflector made by the General Electric Company. The globe is made of one piece of glass, the sides of which are silver plated and covered with a coating of copper. *D* is a dustproof cover shown attached to a standard R. L. M. reflector unit. Both are made by the Benjamin Electric Manufacturing Company of Chicago, Ill. *E* is a dustproof lighting unit developed by the Ivanhoe Division of the Miller Company, Cleveland, Ohio. The maker points out that cleaning this unit is simply a matter of wiping off the glass plate on the bottom of the unit. *F* is another dust-tight unit developed by the same company for use where the reflectors are inverted or at the side of the structure to be lighted.

Industrial Heating

The continued growth in the use of electric energy for industrial heating purposes was evidenced by an average increase of about 15 per cent in the amount of equipment of all classes produced, is the report received from the General Electric Company.

This company further states that the volume of miscellaneous forms of heating units for application to process machinery was about the same as for 1923, while equipment for industrial ovens for baking japan, foundry cores, and the like was somewhat less.

The most marked increase was in connection with electric furnaces for heat treating and vitreous enameling; the production of this type of furnace showing an increase of approximately 70 per cent over previous demand.

The American Metallurgical Corp., Boston, Mass., has put out a 20-kw., 220-volt, single-phase, electric pot furnace for use in cyanide, lead, or salt hardening and white metal melting. The maker states that the efficiency and the absolute temperature control of this furnace have made it possible for the manufacturers of small tools and parts to produce a quality which is impossible in a fuel-fired unit. The manufacturer further reports that the heat-resisting containers will last indefinitely, as the electric heat never reaches a point where overheating is possible owing to a protecting gold fuse which is inserted between the heating elements and which protects the elements if anything should go wrong with the automatic control instruments.

The manufacturer of Globar, a non-metallic type of resistor used for electrical heating, has changed its name from the Wireless Resistor Company to American Resistor Company. This company, which is located in Milwaukee, Wis., reports that it has improved the process of manufacture so that greater uniformity of the resistor element has resulted. The maker also states that improved types of terminals and supports have been developed for use with this heating element.

Industrial Lighting Equipment

Reflectors and Projectors.—One of the main developments in industrial lighting equipment is the construction of dust-tight units that protect the reflecting surface from discoloration, dirt and corrosion caused by the dusty and smoky atmosphere found in many industrial locations.

Among the recently developed lighting units is the dust-tight equipment made by the Ivanhoe Division of the Miller Company of Cleveland, Ohio. The manufacturer reports that by protecting the inner surface of the reflector with a glass plate sealed with copper gaskets, not only is the efficiency of the reflecting surface retained, but protection for the lamp and electrical connections is also provided. Cleaning then becomes a simple matter of wiping off the glass plate. This unit is shown in one of the accompanying illustrations. This company has also developed dust-tight floodlighting units and protective covers for reflectors inverted below or at the side of the structure to be lighted. These protective covers, which are shown in an accompanying illustration, are

designed to keep rain, snow, or dirt away from the lamp and inside of the reflector.

The General Electric Company has developed a new dustproof unit for industrial plants. It consists of a cast-iron top with a felt globe seat. The globe is all one piece of glass, the sides of which are silver plated and covered with a coating of copper. The bottom is clear rippled glass. The manufacturer states that this unit is very efficient and at the same time it is not hard on the eyes because of the rippled glass on the lower part. This unit is shown in an accompanying illustration. This company has also developed a weatherproof projector, which utilizes standard 110- or 220-volt, 300- to 1,000-watt lamps.

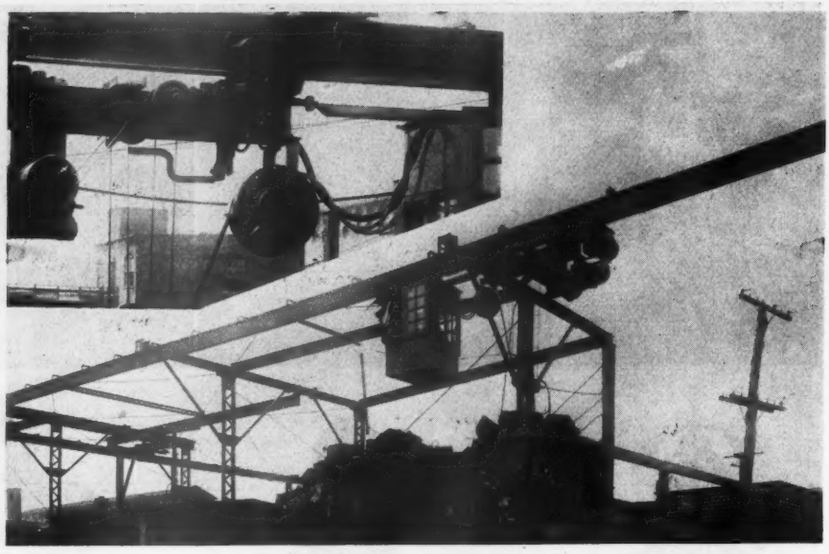
The Benjamin Electric Manufacturing Company of Chicago, Ill., has developed a dust-tight glass cover for use on its 14-in. R. L. M. reflector unit.

A new floodlight projector having a heat-resisting semaphore lens in the front door and a heat-resisting prismatic glass reflector on the inside of the rear door has been placed on the market by the Crouse-Hinds Company, of Syracuse, N. Y. The maker states that this projector is not affected by lamp heat, gases, rain or snow and is intended particularly for use around steel plants and railroads.

The Holophane Glass Company, Inc., of New York, N. Y., has developed a High Mounting Height Unit which it states has an effective candlepower downward of approximately double that of either the deep bowl or shallow bowl type of steel reflectors. The maker reports that this unit is especially adaptable for the illumination of buildings where the lighting units must be hung at considerable heights as above the craneways as shown in a "before and after" illustration accompanying this section.

Tindall & White, Inc., New York, N. Y., report that their Perfection shade has been approved and endorsed by the New York State Industrial Commission as meeting the code requirements in all respects and giving no glare even when used with clear lamps.

Several new types of signal lanterns have been developed by the Nichols-Lintern Co. of Cleveland, Ohio. These lights are intended for use as warning, danger, or signal lights around industrial plant yards and buildings. A feature of the lights is that they have cast-aluminum frames which the manufacturer states will defy rust and acid atmospheres and will not crumple under rough handling; further the lamp bulb is so completely enclosed that it is entirely dustproof and moisture-proof. These lanterns, as shown in the accompanying illustration, are made with cylindrical Fresnal lens or with 1-way or 5-way Corning optical lenses in four different colors as desired. This company has also developed a combination signal lantern and reflector unit using one lamp or two in such a manner that the upper part of the unit is a warning signal while the lower part throws a strong beam of light down on the dangerous area.



Retrieving reels are said to increase the life of magnet cables.

This illustration shows a Mogul type Reelite made by the Appleton Electric Company, Chicago, Ill., installed on a monorail crane in a junk yard. This Reelite automatically pays out and retrieves 45 ft. of No. 8 four-conductor cable as the magnet is hoisted and lowered.

Lamps.—Probably one of the biggest developments in lamps was the announcement by the General Electric Company of a reduction in price of approximately 10 per cent on nitrogen-filled, Mazda lamps ranging in size from 100 to 1,000 watts. The lamps on which the reduction was made comprise the bulk of the lamps used by industrial plants.

A theft-proof lamp has been developed by the Kulp Theft Proof Lamp Company of Chicago, Ill. This incandescent lamp is standard in every respect and resembles other incandescent lamps in appearance, but has the added feature that it cannot be removed from the socket without being destroyed. The base is provided with an outer shell which is sealed to the inner shell. The outer shell is threaded to fit the socket, but the inner shell has no thread. After screwing the lamp into the socket an additional turn breaks the seal between the shells and the lamp then turns freely around in the socket. The only way to remove it is to break the glass and reach the outer shell. This lamp is being made in all sizes, both vacuum and gas-filled, and is said to cost no more than other lamps without the theft-proof feature.

Miscellaneous Lighting Supplies.—A device that will clean and polish the light fixtures directly from the floor has been placed on the market by the Electric Light & Reflector Cleaner Company of Appleton, Wis. The apparatus consists of a set of telescoping tubes, the upper tube controlling three arms that grip the reflector under spring tension and prevent it from turning. Inner tubes control the brush mechanism. A handle at the bottom raises the mechanism into contact with the reflector and lamp, while the lever at the side of the handle holds the brushes against the surface to be cleaned. A crank at the bottom revolves the brush mechanism.

The Thompson Electric Company of Cleveland, Ohio, has changed the name of its safety disconnecting hanger to Thompson Safety Lowering Switch. This name was thought to be more typical of its function. The maker states that this device enables all lamp maintenance work to be done on the ground, thus eliminating all climbing and electrical hazards, and making the work more likely to be done. The new underslung design involves several improvements.

In this model all of moving parts except the wheel are lowered to the ground with the lighting unit; provision is made for enclosing the line wires entering the upper member of the device and also for dead-ending the chain, as well as for enclosing the chain in conduit.

The American Fixture Company of Milwaukee, Wis., reports that its industrial, adjustable light fixtures are now made for attachment directly to the conduit fitting.

Wiring Devices

A new type of wire connector has been developed by the Ideal Commutator Dresser Company, of Sycamore, Ill. The manufacturer states that this device does away with the use of tape, solder and blow torch and decreases the time required to make wire joints. These connectors come in several sizes to handle all regular stranded and solid wire combinations. To make a joint, the wires are skinned and twisted, leaving about an inch of wire exposed. The connector is then screwed on to the twisted pair of wires. Inside the connector is a copper-covered steel wire coil that bites into the copper wires and which is said to hold them fast, making a perfect mechanical and electrical connection.

A "Ground It" bushing has been developed by the Groundulet Company, Newark, N. J., for use on conduits which are to be grounded or otherwise electrically connected. The bushings are made of malleable iron, galvanized and provided with an ear which is drilled and tapped to receive a stud. The stud is provided with a socket to which the grounding wire may be soldered. A hole is located in the bushing in such a position that when the stud is screwed into place, the stud comes into contact with the threads of the conduit. This not only establishes an intimate electrical contact with the conduit, but it also locks the bushing firmly on the conduit and as the stud thread is mutilated when the stud is screwed home, there is little possibility of its working loose.

A new weatherproof, armored connector for electrical circuits has been developed by The Ohio Electric & Controller Company of Cleveland, Ohio, for use where connections must be made and broken frequently and kept insulated, especially where they are exposed to hard knocks or the weather. Connection and disconnection are affected without tools by a double bayonet type lock as shown in one of the accompanying illustrations.

A complete line of pipe fittings which are designed for use with common wrought-iron or steel pipe in the erection of outdoor or indoor electrical switching equipment, has been placed on the market by the Westinghouse Electric & Manufacturing Company. While they are designed primarily for electrical installations, the new fittings are equally applicable for the construction of racks, railings and bench or table frames.

The "Shurlock" is a locking feature that has been developed by Pass & Seymour, Inc., of Syracuse, N. Y. This feature is designed to prevent the unauthorized removal of lamps from their sockets. It also may be used to prevent lamps from loosening in their sockets due to excessive vibration.

Construction and erection costs can be reduced through the use of the Adaptibox line of conduit fittings is the report received from the Adapti Company of Cleveland, Ohio. These conduit fittings instead of being made in one piece, consist of a base having four interchangeable sides. This feature permits any special requirement to be instantly met by the contractor or plant engineer, right on the job if necessary, by reassembling standard units to make up the types needed. Also since the outlet sides can be screwed on to the conduit and afterwards attached to their respective bases, it is in many cases possible to assemble entire sections of the conduit on the floor and then attach them to the bases already in place on the ceiling.

The Arrow Electric Company inform us that their new Arro-Grip feature has been extended to a complete line of sockets and rosettes as well as to the attachment plugs.

A new switch-plug has been developed by Harvey Hubbell, Inc., of Bridgeport, Conn. In many shop and factory installations the ceiling lighting unit closes up the only con-

Wiring devices that have been devised to fit special conditions.
At *A* is shown a connector that is intended to take the place of solder and tape when splicing wires. It is made by the Ideal Commutator Dresser Company of Sycamore, Ill. *B* is a socket with a special grip to hold the cord securely to the socket. It is made by the Arrow Electric Company, Hartford, Conn. *C* is a new canopy toggle switch made by Harvey Hubbell, Inc., of Bridgeport, Conn. *E* is a new switch-plug made by the same company. It has been developed to give the combination of a switch and a convenient outlet. *D* is a bushing developed by the Groundulet Company of Newark, N. J., for making a good ground to a conduit. In *F* is shown a new weatherproof armored connector developed by The Ohio Electric & Controller Company of Cleveland, Ohio. It was especially designed for making an easily-broken connection at the magnet end of a lifting magnet cable.

venient or available outlet to which a heating appliance, fan, motor-driven appliance, or any other electric device used, can be connected. To meet this unfavorable situation, the Hubbell switch-plug was developed. It combines both an independent switch for the ceiling unit and a T-slot outlet into which an electric device can be plugged. The switch controls the light only; the outlet is always "alive."

This company has also developed a multiple plug which may be plugged into a single plug outlet thereby converting it into a double outlet.

A new remote control switch rated at 15 amp., 125 volts, has been developed by the Hart Manufacturing Company of Hartford, Conn. The maker informs us that this switch was especially designed for the automatic switch control of small amounts of current and is adapted for the control of small motor-driven sirens and oven units with thermostatic control.

A new conduit box switch, known by the trade name Levolier, has been placed on the market by the McGill Manufacturing Company of Valparaiso, Ind. This switch is rated at 6 amp., 125 volts, or 3 amp., 250 volts, and is intended to do away with the necessity of running extra conduit to the switch, inasmuch as the conduit box switch is installed at the fixture.

A new model of the Autex automatic extension reel is reported by The Cincinnati Specialty Manufacturing Company of Cincinnati, Ohio. The maker states that this new model has an improved side contact, a new clamp which was added to hold the cord secure, and that the reel is now equipped with Belden Tuff Rubber Cord instead of the fabric cord previously used. Two sizes of reels are made: one having a 9-in. disk and carrying 25 ft. of cord and the other having a 13-in. disk and carrying 50 ft. of cord.

The Appleton Electric Company of Chicago, Ill., informs us that many manufacturers are making operation of portable tools more convenient through the use of Reelites for paying out and retrieving the cord running from the power supply outlet to the tool. This company also informs us that its Mogul type Reelite is finding extensive application for paying out and retrieving the power supply cable on magnet handling cranes.

During the past year the Truscon Steel Company of Youngstown, Ohio, has developed a steel pole of copper bearing steel which is said to do away with rusting and the costly galvanizing which has heretofore been required on steel poles to prevent rusting.

How Maintenance Is Handled

(*Continued from page 51*)

This continual watch for mal-adjustments, etc., does much to prevent serious troubles and consequent loss in production machine hours.

A straight-line organization is in effect, with the works engineer in charge. The following men are responsible and report to the works engineer:

Millwright foreman
Chief electrician
Janitor foreman
Watchman
Elevator operators
Safety inspectors
Construction gang foreman during construction periods
Foreman of millwright dept. at Cortland Works.

Aside from these responsibilities as works engineer, the writer is president and manager of the Corona Building and Improvement Company, Inc., a subsidiary of the parent company. This company has purchased land, laid out streets, sewer systems, etc., and erected 83 homes and maintains them and also owns and operates a rooming house consisting of 32 rooms, dining room and kitchen and garage which is furnished to the parent company for the storage and maintenance of its trucks and passenger cars.

Maintenance Tools and Equipment

(*Continued from page 89*)

Electric Company allows welding operators to make a quick change from burned stub to new electrode. The maker points out that the operator need only strike the stub end of the old electrode, causing it to drop out, when the new wire can be inserted instantly without unnecessary effort.

Miscellaneous Supplies.—A voltage tester that does not require the use of lamps has been announced by the Square D Company of Detroit, Mich. The maker informs us that this tester will indicate whether the current is a. c. or d. c. and will also indicate potentials from 125 to 500 volts. It is intended to replace lamps in locating open circuits, blown fuses, and motors running single phase. It may be used in emergencies as a voltmeter.

A new product, known as Imperial Commutator Cement, has been placed on the market by the Martindale Electric Company of Cleveland, Ohio.

Several new insulating varnishes have been developed by The Sterling Varnish Company of Pittsburgh, Pa. Among these is Jetlac, a spirit finishing varnish that the manufacturer states air dries in from 2 to 10 min., depending on the method of application. It is said that this material gives a beautiful, deep glossy black coat that is oil-proof and very resistant to water, acids and alkalis; also it is flexible and heat enduring. The maker also informs us that he has developed a complete and entirely distinctive line of baking insulating varnishes, that are designed especially for application to coils wound with enameled wire. These varnishes range from those which, because of their unusual mechanical strength are especially adapted to the treatment of high-speed motor armatures to those that are characterized by their adhesiveness and extreme resistance to heat. They are oil-resistant but at the same time provide protection against water, acids and alkalis. Their special solvent, having an extremely high flash point, is said to render them as nearly non-inflammable as is at present possible.

W. J. Jeandron states that four new grades of Le Carbone brushes have been recently developed. Grade EGA is reported to be especially adapted for 250-volt rotary converters and motor-generator sets where the speed is not in excess of 4,500 ft. per min. and the current density is about 55 amp. per sq. in. Grade EGSP is said to be adapted to 500-volt rotary converters and motor-generator sets with approximately the same speed and current density as listed above. Grade EGH is designed for automatic rotary converters where the brushes run in a trailing position. Grade CG 3,371 is intended for use on bronze rings on rotary converters where the current density does not exceed 100 amp. per sq. in. and a ring speed of approximately 4,500 ft. per min. The maker informs us that this brush has a low co-efficient of friction and causes little ring wear.

A new, unique and efficient drill has been developed by the Van Expansion Bolt Manufacturing Company, Chicago, Ill. This drill is intended for use in drilling holes in brick, concrete or stone. It has fluted or grooved sides which permit ample clearance. Inasmuch as the diameter of the drill is the same throughout its entire length, it never becomes undersize. The manufacturer reports that the drill is so tempered that the life of the drill is practically unlimited, as it can be re-sharpened and used as long as enough stock is left to hold in the hand or insert in the chuck.

The Westinghouse Electric & Manufacturing Company has informed us that a means has been recently perfected for forming micarta rod with the laminations concentric to the axis and with the center as solid as the exterior portion. Such a rod can be machined without the difficulty of splitting out, as is the case with the soft-core rod.

Mechanical Power Service Equipment

(*Continued from page 64*)

power tank, known as M116 and M109 respectively, for use with the "Dot" high pressure lubricating system. The electrically driven outfit comprises a cylinder made from heavy, seamless brass tubing in which the lubricant can be put under any pressure up to 2,500 lb. per sq. in. by means of a 3-piston booster pump driven by a small electric motor. The pressure can be adjusted to any desired value up to 2,500 lb., by means of check nuts back of the piston springs. This outfit is mounted on wheels for easy transportation around the plant.

The hand-power tank consists of a cylinder made of seamless brass tubing, in which any pressure up to 3,000 lb. per sq. in. may be developed by bearing down on the handle of the booster pump. There is a ball valve at the base of the pump which opens with each stroke of the plunger and immediately closes at the end of the stroke, thus maintaining pressure in hose and gun.

Star Expansion Bolt Company, New York, N. Y., has placed on the market a new device known as the "Dryvin Anchor," for making attachments to masonry or brickwork. This consists of a metal shield and lead sleeve which are inserted in a hole drilled in the brickwork. The shield is then expanded by driving a nail into it. This shield is made in several sizes ranging from 3/16 in. to 1/2 in. diameter and it is claimed will develop ultimate holding loads from 400 to 4,000 lb., in good masonry. Other claims are that the expansion takes place below the surface of the masonry and that the pressure is distributed over a large area.

A new line of gooseneck welding torches has been developed by The Bastian-Blessing Co., Chicago, Ill. It is claimed that these torches are an improvement over other torches of similar design in that the gases do not mix in or near the operator's hand and that they contain all of the features patented by this company for the elimination of backfire and production of maximum efficiency of gas mixture.

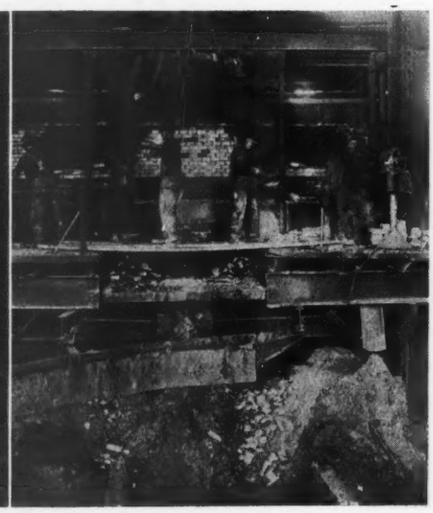
Weiss Engineering Corporation, Newark, N. J., is introducing the Weiss universal joint, of which it is claimed that the distinguishing feature is that it transmits uniform angular motion when driven at a uniform rate. Each end of the joint is formed with four jaws projecting in the direction of the shaft, which interlock with the corresponding jaws of the other member. Rolling contact is maintained between the two principal members by means of a series of balls, through which the driving torque is transmitted. These balls are held in specially-formed raceways so that each ball is sunk approximately half its diameter in the face of one jaw and an equal depth in the opposing face of the next jaw.

The American Blower Company, Detroit, Mich., is now producing a Venturafin Heating Unit having about three times the heating capacity of the original Venturafin Unit Heater which was placed on the market last year.

It is claimed that these heaters are unique in that they make use of a peculiar form of tubular construction. The steam tubes are of thin copper, offering little resistance to the passage of heat. Still higher transmission efficiency is given by winding the tubes with a helical brass "fin," which gives them about three times their ordinary heat-radiating surface. These tubes are assembled into units and forced circulation of air through the tubes is provided by a motor-driven fan.

The small unit weighs 320 lb. and has a capacity ranging from 125,000 to 162,500 B.t.u. per hour, depending on the initial and final temperatures. The larger unit delivers from 500,000 to 650,000 B.t.u. per hour and weighs 1,060 lbs.

At the left are shown two of the seven Venturafin unit heaters, made by American Blower Co., installed in a large planing mill. Center, portable, single-inlet, H.S. fan for induced draft in brick kilns. Right, a No. 7 Man Cooling Fan on duty in a Southern steel mill.



Material Handling Devices That Pay

(*Continued from page 70*)

existing equipment or to incorporate new developments. Four of these new developments have been illustrated on page 70. One of these has been added to the line of the Roeper Crane & Hoist Co., Inc., Reading, Pa., which was formerly known as the Reading Crane & Hoist Co. Some new developments have been added to the Lo-Hed electric hoist manufactured by the American Engineering Company, Philadelphia, Pa. This hoist is so constructed that the hook can be drawn up close to the rail, thus making the hoist available in places where the headroom is very low. Still another electric hoist, known as type CM was developed by the Chisholm-Moore Manufacturing Co., Cleveland, Ohio. This hoist contains a standard enclosed crane motor; a controller especially built for hoist service; two reductions in spur gear; a Weston load brake; a mechanically operated motor brake and other features.

The Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., has added the LiftAbout, Jr., which is built for handling 500-lb. loads, to its line. This is very similar to the LiftAbout, except that it is of less capacity, and is built for handling light loads quickly, such as rolls of cloth in textile mills, baskets of cans in canning factories, handling materials for pickling, handling machine products for cleaning, dipping or painting operations, for serving lathes and other machines.

The Sullivan Machinery Co., Chicago, Ill., has increased its line of air and steam hoists, by adding a 1-ton capacity electric hoist to its line. In addition, the Ingersoll-Rand Co., New York City, is now offering a new line of air motor hoists made in five different sizes with capacities ranging from 500 to 10,000 pounds.

Two new types of cupola chargers were developed during the past year. The type developed by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., is constructed in either cage or floor operated electric hoist types and carries the load on an extension beyond the trolley with the cage acting as a balance to the load. The charge is handled in drop-bottom buckets, with magnets or in grab buckets.

A cupola charging hoist for somewhat similar general operation was also brought out by The P. H. & F. M. Root Co., Connersville, Ind. In one installation of this cupola charger a crew of three men did the work formerly requiring six men. Here the cupola was charged with 150 tons per day or 19 tons per hour. The complete cycle of operation of each charge from the scales to the cupola and return required six minutes for each 10,000 pounds of charge so that the hoist was operating about 50 per cent of the time.

Several interesting features are incorporated in the 10-ton crawling crane brought out by the Industrial Works, Bay City, Mich., for general yard use for handling coal and miscellaneous purposes. An improved model of the 20-ton locomotive crane has been brought out by The Brown Hoisting Machinery Co., Cleveland, Ohio.

Magnets are being applied as a part of practically all hoisting equipment handling iron or steel. Many unusual applications have been reported. In one case an Ohio magnet is used to dip rolls of wire in an acid bath. The magnet is protected by frequent coatings of asphaltum paint.

Three conveyor developments have been reported by the Stephens-Adamson Mfg. Co., Aurora, Ill. One of these is a portable, high-speed, belt-conveyor, box-car loader for throwing material into the farthest corner of the box car. This may also be used for unloading cars. The other developments consist in adopting high pressure lubrication to the ball bearing unit carriers for belt conveyors and also for the conveyor chain. These two parts of the equipment have been extremely difficult to lubricate and are continually operated under extremes.

Users of conveyors are paying considerably more attention to specifying the use of ball bearings and better methods of lubrication for both gravity conveyors and also for the rolls supporting belts in other conveyors.

Conveyors are occupying an important place in material handling, especially where an almost uniform and continuous supply of material is to be delivered over a fixed path. Belts and bucket conveyors also have well demonstrated their value in handling loose material. For example, one belt conveyor system, containing almost 4½ miles of 48-in. conveyor belt, carries coal from a mine to the loading station at the continuous rate of 1,200 tons per hr. This has taken the place of locomotives, cars, track and the difficulty of unequal distribution of the deliveries of coal as well as a large force of men. Belts are also used for carrying supplies that must be mixed in certain proportions such as the constituents of brass or rubber, to weighing scales and from there to the process. Another interesting conveyor installation reported by Weller Mfg. Co., Chicago, Ill., is a special conveyor used to store and reclaim beets at a Western beet sugar factory.

A number of interesting applications of roller and slat or apron conveyors have also been reported from practically all industries. Many concerns are finding that progressive assembly can be adapted to many industries and processes, cheese making, for example, and is not limited to straight mechanical assembly operations as in the automobile industry. Practically all of the new sawmills, large planing mills and shook plants are handling much of the material by conveyor systems. Many plants are finding conveyors much more economical than the use of large gangs of men even though labor was not so difficult to obtain. The economy feature, however, well repays the investment.

Other miscellaneous new equipments reported are: A new type of trailer for tractor service, by Mercury Mfg. Co., Chicago, Ill.; additional pressed-steel boxes and platforms for hand- and power-lift trucks, by The Youngstown Pressed Steel Co., Warren, Ohio; improved models of hand and electric "Transveyors," by Cowan Truck Co., Holyoke, Mass.; and a new Super Multiple-Lift hand-lift truck by Stuebing Truck Co., Cincinnati, Ohio., by which one man can handle 5,000-lb. loads in four short lifts.

With the increasing knowledge of the value and economy which may result from the use of material handling equipment, the coming year will no doubt show much greater utilization of this equipment.

EDITOR'S NOTE: Special acknowledgment is made to the following companies for their assistance in furnishing information on material-handling equipment: American Engr. Co., Philadelphia, Pa.; The Baker R. & L. Co., Cleveland, Ohio; Barrett-Cravens Co., Chicago, Ill.; Bond Foundry & Machine Co., Manheim, Lancaster Co., Pa.; The Brown Hoisting Machinery Co., Cleveland, Ohio; Chisholm-Moore Mfg Co., Cleveland, Ohio.; Cleveland Crane & Engr. Co., Wickliffe, Ohio; The Crescent Truck Co., Lebanon, Pa.; Cowan Truck Co., Holyoke, Mass.; The Dow Co., Louisville, Ky.; Econ-

omy Engr. Co., Chicago, Ill.; The Elwell-Parker Elec. Co., Cleveland, Ohio; Faultless Caster Co., Evansville, Ind.; Harnischfeger Corp., Milwaukee, Wis.; The Jeffrey Mfg. Co., Columbus, Ohio; Industrial Works, Bay City, Mich.; Ingersoll-Rand Co., New York City; The Lamson Co., Syracuse, N. Y.; Lewis-Shepard Co., Boston, Mass.; Link-Belt Co., Chicago, Ill.; Mercury Mfg. Co., Chicago, Ill.; New Jersey Foundry & Machine Co., New York City; Ohio Elect. & Controller Mfg. Co., Cleveland, Ohio; P. H. & F. M. Root Co., Connersville, Ind.; Roeper Crane & Hoist Co., Reading, Pa.; Service Caster & Truck Co., Albion, Mich.; Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; Standard Conveyor Co., North St. Paul, Minn.; Stephens-Adamson Co., Aurora, Ill.; Stuebing Truck Co., Cincinanti, Ohio; B. F. Sturtevant, Boston, Mass.; Sullivan Machinery Co., Chicago, Ill.; Weller Mfg. Co., Chicago, Ill.; The Yale & Towne Mfg. Co., Stamford, Conn.; The Youngstown Pressed Steel Co., Warren, Ohio.

Mechanical and Electrical Changes

(*Continued from page 54*)

of our motors from open-type sleeve bearings, to inclosed-type roller bearings in some of our dusty and dirty departments where there is a great deal of flying dust, sand and chips.

We expect to make several changes in the machines in the machine shop, in order to avoid double handling, and to increase the number of pieces machined per day.

Several changes in the lighting conditions in several different departments have been started in order to get better light for the employees, and to have it where it is needed and can be used to the best advantage.

It is expected that several changes will be made in belt-driven machines, changing them to chain drive and thereby increasing the power and doing away with belts and shafting.

We have recently put into service two large portable electric drills with capacities up to 1½ in., in order that heavy repairs can be made on the job without taking the work to the shop. One drill is a three-phase, 220-volt machine and the other is a universal 220-volt, a.c. and d.c. machine.

* * * *

Keene Richards, Industrial Engineer, Grennan Bakeries, Inc., Detroit, Mich.—For our lighting installation we have standardized white enameled steel reflectors and the grouping of the lighting switches on a panelboard in each department. This panelboard is so located that the fuses are locked up and accessible only to the electrician, while the switches are exposed and are operated by the department foremen.

Many departments have not been changed over in this way, but we contemplate making these changes within the next year.

Lighting circuits have been so grouped that the parts of the room which get dark first are on a separate circuit.

We are gradually changing over all switches on production machines which are started and stopped frequently, to remote control even though the motor may be only of one or two horse power. We find that this change-over costs us about $65 but soon pays for itself in absence of fuse trouble, etc.

As our machinery is used in the manufacture of food products and requires daily washing, we found it practically impossible to mount the ordinary type of switch on or near the machine and not get into trouble. We now mount a water-tight, control button directly on the machine, with the remote control switch back on the wall or column.

We have for some time used direct-connected motor drive on all motor equipment. This policy we are continuing. There are a few cases where group drive might be more efficient, but in a plant handling food products overhead shafting and belting cannot be tolerated.

Elevator maintenance is a difficult and expensive item. In new plants and additions we are installing conveyors and not elevators, as we find that a properly-designed conveyor system is cheaper, easy to maintain, more efficient and more flexible. We have even gone so far as to install a conveyor for receiving material in order to relieve the load on elevators.

I would like to place particular emphasis on the use of remote control switches even for very small motors. The saving on fuses and maintenance on an installation costing $65 or $75, as against the ordinary protected switch costing $5 or $6 will very easily pay for itself in two years exclusive of the amount of time saved by keeping the machine in service.

* * * *

W. T. Price, Works Manager, Westcott Valve Company, Inc., Seneca Falls, N. Y.—We have not made any changes during the past year, as we did not think any were necessary, for the reason that we have not had any trouble.

All of our lines were installed with considerable forethought and have stood the test. All lines from which motors are drawing power were installed 50 per cent heavier than was necessary. This has proven good judgment as we have been able to add motors to the line without lowering the efficiency of said line.

All motors are kept clean and well oiled, and are looked after twice a week. All motors are installed with knife switch fuse box and protected by an overload device, with an automatic starter ahead of these. We have found that this was good judgment as it practically eliminated all motor troubles.

We do not contemplate any changes in our present equipment, other than those occasioned by moving our plant to another city.

If we had the necessary capital and could do so, we would have every machine in the plant a direct-connected, electrically operated unit, excepting the real light machines.

* * * *

L. A. Wynd, Chief Electrician, Keystone Steel and Wire Company, Peoria, Ill.—The Keystone Steel & Wire Company has made one important step in the application of power during the past year. Briefly, this step consists of using an 80-hp., mill-type motor as a booster on one of our main drives.

Last July, mechanical changes in the rod mill increased the tonnage to the point where additional power was necessary to drive the mill to its limits consistently.

A spare General Electric Co. MD 107 series motor was changed to compound by a replacement of the field coils and belted to the 1,300-hp. finishing mill main drive motor with the idea of slightly boosting the finishing mill power. As this motor is belted to the main motor it requires no starting resistance and is placed in operation automatically by first closing the shunt field circuit and then closing the armature circuit through a magnetic contactor interlocked with the main motor control at the top-speed position. This experiment is working so well that plans are now under way to purchase two larger motors and belt them to the finishing and roughing mills to assist the main motors.

The new booster motor on the finishing mill will be a 2,300-volt, three-phase, 60-cycle, wound-rotor motor of 250 hp., belted to the mill and arranged to be cut in on the line through an oil-immersed magnetic switch as soon as the Schebius-regulator-controlled 1,300-hp. main motor reaches its highest speed above synchronism. The finishing mill part of the rod mill is worked at top speed about 98 per cent of the time and a more expensive control for the booster is not justified. The installation of this motor presents a comparatively simple problem.

A 300-hp., 230-volt, d.c., shunt interpole motor will be used to boost the power of the roughing mill and must work with the 2,300-hp. Scherbius-regulated main motor. This booster motor will be cut into service at point 15 above synchronism and will work through the rest of the range to point 24 above synchronism, which is top speed for the main motor. Its armature current will be held close to 100 per cent at all points through automatic field regulation. No starting resistance will be necessary. This application, while more complicated than the one on the finishing mill, is perfectly practical.

* * * *

A large paper mill reports that the only change of importance made during the past year was in changing the paper machine drive from steam engine to electric motor. Originally this machine, which was of the electric drive type, was supplied from a d.c. generator driven by a steam turbine. Trouble developed in the turbine, causing fluctuations which were annoying. Recently the turbine was taken out and a 350-kva. synchronous motor connected directly to the generator. As the average load on this motor is only 180 hp. the remainder of the available capacity is utilized for power factor correction.

Previously, a 400-kva. synchronous motor floating on the line was used for power factor correction only. After the installation of the 350-kva. motor it was found possible, by over-excitation of the latter, to dispense entirely with the larger motor. The costs of the steam and electric generator drives were found to be practically the same, while the paper machine operates much more satisfactorily with the constant-speed generator drive.

Practical Books

For Your Personal Library

Every man who aspires to larger responsibilities should build up a professional library. Copies of these books may be obtained from the publishers mentioned.

Light and Work—By M. Luckiesh, Director, Lighting Research Laboratory, National Lamp Works of General Electric Company. Published by D. Van Nostrand Company, 8 Warren street, New York, N. Y., 290 pages, 70 illustrations, price $4.00.

This book presents a very practical discussion of the relation of quality and quantity of light to effective vision and efficient work. It presents material of use not only to the designer but also to all users of light and particularly to men connected with the application of light to industrial plants. Artificial light has become a serious competitor of daylight on a cost basis and is far superior from the viewpoint of control. The author compares artificial light with natural lighting on the basis of quality, quantity, and cost. A discussion is given on the best range of illumination intensity and also the best quality of light for effective work as influenced by efficient vision. Some rather surprising conclusions are reached pertaining to the economic value of adequate and proper lighting and to the amount of artificial light that we can afford to use at the present time. Chapters of particular interest to industrial men are those pertaining to light and production, the value of proper maintenance of lighting systems, the lighting value of paint, visibility and safety, and the most effective and economical intensity of illumination.

* * * *

Applied Electricity for Practical Men—By Arthur J. Rowland. Published by the McGraw-Hill Book Company. Second edition, 431 pages, price $2.50.

The first edition of this book was brought out in 1916. The revision includes many changes and new material to bring developments in the application of electricity up to date. For the most part the book deals with fundamental principles of interest to electricians who are engaged in construction and operating work on lighting and power systems. It will also be found a useful text in vocational and trade schools.

* * * *

Principles of Electroplating and Electroforming—By William Blum, chemist, U. S. Bureau of Standards, and George B. Hogaboom, electroplating adviser, U. S. Bureau of Standards. Published by McGraw-Hill Book Co., 370 Seventh Avenue, New York, N. Y. First edition, 356 pages, illustrated, price $4.

The authors have for several years been engaged in the study of electroplating and electroforming processes and this book has been prepared to assist those in the industry to apply the results that have been, or may be, secured in various research institutions.

In keeping with the object, considerable space is devoted to an easily-readable exposition of the chemical laws and principles of electrochemistry concerned in the electrodeposition of metals from aqueous solutions. In the succeeding chapters such subjects as, factors governing character of deposits, preparation for electroplating, preparation for electroforming, electrical equipment, tanks and their equipment, and the deposition of copper, nickel, zinc, lead, tin and other metals are discussed in detail. An appendix contains a number of very useful tables.

In many respects this book is a noteworthy addition to the literature on this branch of the electrochemical processes and is deserving of a place in the library of everyone who is interested in the subject from any standpoint.

* * * *

Industrial Electricity—Direct Current Machines—By William H. Timbie, Professor, Electrical Engineering and Industrial Practice, Massachusetts Institute of Technology. Published by John Wiley & Son, Inc., New York City, 721 pages, 469 illustrations. Price $3.50.

This book was written to meet the demand from technical schools and electrical workers for a text covering the important principles of electrical science as applied to modern industry. The purpose of the book is to explain how direct-current electricity is generated, transmitted and used, and to afford an adequate foundation for further study of the application of alternating-current electricity to modern practices. The problems are based on the principles of present day industrial practices. Over a thousand typical examples and practical problems, based on engineering data, have been added to emphasize the principles and illustrate their uses. Explanations are made in a simple and practical way in a language which a student can easily understand and without the use of mathematics beyond simple algebra.

* * * *

Magnets—By Charles R. Underhill. Published by McGraw-Hill Book Co., 370 Seventh Ave., New York City, 449 pages, price $4.00.

This is a practical treatise on electromagnetic devices, their circuits, and the specific forms and characteristics of electromagnets and permanent magnets. The author is a well-known consulting engineer and authority on this subject who has had a wide experience in the design of electromagnetic devices. While the book contains certain technical information, the discussions are intensely practical and refer to the applications of magnets in all equipment that uses them. The information is not only of value to the designer but to the operator who must inspect and repair magnets. This book will be found to be a very complete and useful reference. The subjects treated are as follows: forms of electromagnets; mechanical forces of electromagnets; time and polarity characteristics; portative electromagnets; switching, control, and protective apparatus; relays; miscellaneous electromagnetic devices; solenoids; constant-current solenoids with plungers; test characteristics of solenoids with plungers; general characteristics of solenoids with plungers; direct-current electromagnets; electric circuits and their phenomena; constant-impressed, direct-voltage, current-time characteristics; magnetic circuits and their phenomena; series and shunt magnetic circuits; magnetic materials; air gaps and magnetic leakage; alternating-current phenomena; series and parallel alternating-current circuits; alternating-current solenoids; alternating current-electromagnets and mechanisms; electromagnets in general; and permanent magnets.

* * * *

Handbook for Electrical Engineers—By Harold Pender, editor-in-chief. Published by John Wiley & Sons, New York City. Revised edition, 2,196 pages, price $6.00.

This handbook was originally brought out in 1914. The necesary revisions to bring it up to date have been made throughout all sections. In addition, new material has been added on the following subjects: frequency changers, electric ignition; phase converters and balancers; electric propulsion of ships; starting and lighting systems for automobiles; and electric welding. Of the main articles 17 have been entirely rewritten and considerable change has been made in 24 other articles. The general plan of the book remains the same, with an encyclopedic arrangement of subjects, and a topical list of articles with page numbers supplemented by an elaborate index.

In the revision of this book Harold Pender, the editor-in-chief, has been assisted by Wm. A. Del Mar, who is a well-known authority on electrical distribution. Forty-two other associate editors who are authorities along particular lines of electrical work have helped on the revising and rewriting of articles in this edition. This book is, therefore, a carefully-compiled, up-to-date handbook covering all phases of electrical work.

* * * *

Conduit Wiring—By Terrell Croft, consulting engineer. Published by McGraw-Hill Book Company, 370 Seventh Ave., New York, N. Y., 441 pages, 700 illustrations, price $3.00.

The author deals exclusively with the conduit method of interior wiring, as this method has become the most important of all now in use. The book is written primarily for the man who installs or who directs the installation of the wiring; however, it is equally useful to the engineer, architect or superintendent who plans the installation.

This book explains how to install conduit wiring for all types of buildings, and for all types of work. It covers the conduit wiring job from start to finish, explaining each procedure, step by step, describing tools and materials and pointing out exactly what to do and how to do it.

Specifically, the subjects treated include conduit wiring materials and supplies, method of laying out a conduit job, conduit manipulation and tools, installing concealed and exposed conduit, testing out, splicing and taping conductors, methods of grounding, and the application of conduit wiring in damp and otherwise hazardous places.

Trade Literature
You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog desired, as given in these columns.

J. E. Rhodes and Sons, 35 North Sixth Street, Philadelphia, Pa.—A 65-page, pocket-size, "Belt User's Book," contains a number of useful rules, suggestions and information on the selection, installation and care of leather belts.

Foamite - Childs Corporation, Utica, N. Y.—A booklet entitled, "Correct Protection Against Fire," is a popular treatise on fire protection for all sorts of risks, and is written in non-technical terms so that the suitability of any type of fire extinguisher for any particular risk may be determined by the layman. One feature of particular interest is a large chart showing the effect of each of the various types of fire extinguishers upon different types of fires.

Boston Woven Hose and Rubber Company, Cambridge, Mass.—A 72-page booklet entitled, "Standards of Practice for Rubber Belting," is written in plain, easily-understandable language and discusses rubber-covered and friction-surfaced belting, the construction and characteristics of these beltings, their application and care, and rules for belting practice. In addition it contains charts and tables for making belting calculations. This is a book which will be of much value to those who use fabric-base belting.

The Van Dorn Iron Works Company, Cleveland, Ohio—Catalog 1004 on, "Convertible Steel Shelving," takes up the capacity and principles of construction and by means of illustrations describes a large number of applications of Van Dorn steel shelving.

General Electric Company, Schenectady, N. Y.—Bulletin Y-2057 entitled, "The Most Efficient Gears for Any Shop," illustrates eight Fabroil gear installations and describes how they solved difficult transmission problems.

Lyon Metallic Manufacturing Company, Aurora, Ill.—Bulletin 105-A entitled, "Lyon Steel Tool Room Equipment," shows by illustrations and diagrams typical shelving, racks and enclosures for toolroom purpose.

Electric Tester Manufacturing and Sales Corporation, 74 East Sixth Street, Portland, Ore.—A folder describes the Universal fuse and circuit tester which may be used on either alternating- or direct-current circuits carrying from 110 to 600 volts. This device eliminates the use of the ordinary test lamp.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—Bulletin 4048 describes the Allis-Chalmers-Timken roller shaft bearing, which is made in a housing interchangeable with most of the Allis-Chalmers adjustable collar-oiling shaft bearings, as well as with a number of other makes. This bearing is built in standard sizes for $1\frac{11}{16}$-in. to $4\frac{15}{16}$-in. shafts.

Palmer-Bee Company, 2778-2804 East Grand Boulevard, Detroit, Mich.—Bulletin B-45 entitled, "Speed Reducers," gives a general description, with numerous photographs and drawings, of the construction, operation and the points of superiority claimed for the Palmer-Bee mill-type, spur gear speed reducers which are made in capacities ranging from ¼ to 500 hp., and in ratios from 1.48 to 1, up to 4,000 to 1. This bulletin also contains instructions for ordering and how to select a speed reducer from a number of tables given. Worm gear and right-angle drive speed reducers are also described, as well as high-speed and mill-type Palmer-Bee flexible couplings.

The Berger Manufacturing Company, Canton, Ohio—Catalog 20-B covers the line of Berloy steel bins and shelving, indicates their method of construction and erection and also shows a large number of installations.

The Cleveland Twist Drill Company, Cleveland, Ohio—A 32-page booklet entitled, "Tools for Tuning Up," lists some of the drills, reamers and screw extractors which are most commonly used in repair shops. A folder entitled, "The Best Way Out," describes the Ezy-Out screw extractor in sets for removing broken cap or setscrews or bolts.

Audubon Wire Cloth Company, Inc., Audubon, N. J.—A folder entitled, "A Partition Between," shows some of the various uses of wire mesh for partitions, windows and machine guards. Detailed illustrations show the construction of the joints and of the floor flanges for mounting.

Century Electric Company, St. Louis, Mo.—A folder entitled, "How Century Polyphase Motors Are Built," shows by illustrations the construction of the various important parts.

The Hisey-Wolf Company, Cincinnati, Ohio—Bulletin 3018-S describes the Hisey electric slate and marble drill with a universal, ball-bearing motor which operates the drill at 110 r.p.m. and has sufficient power for drilling holes up to ½ in. diameter in slate and marble. This drill is also adapted for some glass drilling operations.

David Lupton Son's Company, Allegheny Avenue and Agate Streets, Philadelphia, Pa.—Catalog B on Lupton steel factory equipment covers the line of steel shelving with bolted adjustment, steel bins and racks, utility cabinets, bench legs and drawers, steel cabinets, stands and boxes, tool cabinets and stands, tote boxes, foremen's desks and waste bins.

Crouse-Hinds Company, Syracuse, N. Y.—Folder 15 and Bulletin 2058 describe the "Wedgtite" pipe hanger for supporting pipe or conduits from I-beams.

The Bartlett-Hayward Company, Scott and McHenry Streets, Baltimore, Md.—Booklet entitled, "Fast's Flexible Couplings," shows by drawings the construction and by sectional cutaway illustrations the method of lubrication of the Fast coupling which is an all-metal coupling consisting of two generated spur gears, one at each end of the shaft, which are continuously and completely meshed with the generated internal gears of a floating sleeve. Considerable space is given to the principle of lubrication, how to order, how to install and factors to consider in various types of drives. This booklet also devotes space to special couplings, such as telescopic couplings, cut-out couplings, couplings for excessive misalignment and those for large turbo-alternators.

The Mills Company, 5320 St. Clair Avenue, Cleveland, Ohio—A series of folders describe the construction and installation of partitions for factories and offices, for shelving and for standard toilet enclosures.

Monitor Controller Company, Baltimore, Md.—Bulletin 67 describes the Monitor edge-wound resistor, which is designed for heavy-duty service. This resistor is claimed to possess a number of advantages compared with other grids, which are fully explained and discussed. A table gives ratings and approximate dimensions.

Chicago Fuse Manufacturing Company, Chicago, Ill.—An 86-page catalog shows illustrations of Union renewable and non-renewable fuses, Gem enclosed fuses and mica top block fuses, Union links, fuse wire and strip, Union cutout boxes, and a variety of other fittings. This catalog also gives sizes, prices and other information for users.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis.—A circular entitled "Two Feet of Electrical Heat" illustrates and describes several rather unusual installations of electric strip heaters.

Belden Manufacturing Company, 2300 South Western Avenue, Chicago, Ill.—Recent catalogs and price lists have been issued on various Belden wire, cord and other specialties.

The Sanymetal Products Company, 980 East Sixty-fourth Street, Cleveland, Ohio—Catalog 4 illustrates the construction and installation of standard metal partitions for factory, offices and toilets.

Gits Brothers Manufacturing Company, 1940 South Kilbourn Avenue, Chicago, Ill.—A catalog describes the Gits oil hole covers, oil cups and wick oilers, for oiling industrial equipment.

Diehl Manufacturing Company, Elizabeth, N. J.—Bulletin 1650 covers the Diehl line of a.c. and d.c. motor-driven exhaust fans. These fans are built with totally-enclosed motors.

Gilby Wire Company, Newark, N. J.—A 20-page catalog lists, describes and gives the capacity, sizes and other information as well as price on the line of resistance and other alloy wires manufactured by this company.

Associated Manufacturers of Electrical Supplies, 30 East Forty-second Street, New York City—This organization has recently issued a new handbook which contains: Part One—list of officers, committees and representatives on outside organizations; Part Two—

the list of member companies with their executive and associate representatives; Part Three—the first published standards of the Association.

International Chemical Company, Philadelphia, Pa.—A series of folders describe the various cleaning compounds manufactured by this company. For example, compound 2B is used in repair shops and other similar places for cleaning parts that have heavy coatings of grease, muck, paint and caked-on dirt; compound No. 22 is used to prevent rusting; cleaner No. 5 is used for cleaning floors. Other compounds are used for cleaning before plating or japanning, for removing oil after machining and for many other similar cleaning purposes.

Tindall and White, Inc., 329 East Twenty-second Street, New York City—A special folder describes the Perfection reflector which is designed for the purpose of diffusing part of the light and directing part on the working surface. This is especially intended for individual lighting or for localized general lighting.

Green Equipment Corporation, Monadnock Block, Chicago, Ill.—A catalog describing Acme commutator smoothing stones gives a thorough discussion of the different types and grades of stones and gives suggestions as to their use. Other catalogs describe the Aurand commutator slotter which is a portable, hand-operated, power-driven tool for undercutting mica without removing the armature and, in most cases, without even removing the protecting shields or brackets.

H. Kleinhans Company, Pittsburgh, Pa.—Folders describe the Mann arc welder which is made in both motor-generator sets and also for gasoline engine drive. One of the features claimed for this generator is that it maintains a fixed current value. By the use of a small field rheostat in the shunt field circuit, the current value may be changed as desired in a large range of steps from 60 to 200 amp. Another bulletin entitled "Precision Welding" describes the use of this equipment in welding machinery such as crankshafts, which must be united with a specific tolerance of misalignment.

The Texas Company, 17 Battery Place, New York City—The December, 1924, issue of "Lubrication," which is a technical publication distributed by this company and devoted to the selection and use of lubricants, takes up the 2-cycle oil engine—its lubrication and operation.

Columbian Rope Company, Auburn, N. Y.—A 54-page book entitled, "Columbian transmission rope is made, discusses rope drive systems, some advantages of rope drives, grooves and sheaves, the proper rope, how Columbian transmission rope is made, splicing Columbian transmission rope (illustrated with 13 photographs and considerable explanatory text) and other useful information.

The Pyle-National Company, 1334-1358 North Kostner Ave., Chicago, Ill.—Various catalogs describe the line of Pyle-National electric headlights, steam turbo-generators for headlights, Pyle-O-Lytes for floodlighting and "Nonglare" glass reflectors.

The American Injector Company, Detroit, Mich.—"The Engineer's Red Book," is not only a catalog on American injectors and oilers but also contains a large number of pages of interesting data as well as questions and answers for the engineer.

The Hill Clutch Machine and Foundry Company, Cleveland, Ohio.—Bulletin T-220 describes the totally-enclosed industrial-type, spur-gear speed transformer with an oil splash system of lubrication. Customary ratios are from 5 to 1 to 125 to 1 for any size of reducer.

Rollway Bearing Company, Inc., Syracuse, N. Y.—A folder describes the application of Rollway bearings for general-purpose electric motors. This bearing consists of short, heavy rollers.

McCord Radiator and Manufacturing Company, Detroit, Mich.—A booklet entitled, "Economy of Better Lubrication," illustrates and describes with numerous sectional diagrams the advantages, economies and operation of McCord force-feed lubricators.

W. R. Ostrander and Company, 371 Broadway, New York City—A 32-page catalog describes the various types of electrical apparatus, such as annunciators, tell-tale floats, bells and buzzers, relays, push buttons, door openers, sockets and other devices. Other catalogs describe fire alarm systems and other alarm and signalling apparatus.

Chase Metal Works, Waterbury, Conn.—A 38-page booklet entitled, "How to Order Brass," points out what properties in brass are desirable for certain typical uses and tells how to order such material so that the manufacturer will understand exactly what is wanted. This booklet also takes up the different physical and mechanical properties of brass and shows the effect of various alloys and of the different methods of manufacturing. The different tests and what they mean are also explained. A table gives the different common types of brasses and other alloys and their typical uses.

General Electric Company, Schenectady, N. Y.—Bulletin 48,721 entitled, "Direct Heat Electric Furnaces in General Electric Factories," shows the use of a large number of furnaces in various operations such as annealing of castings and wire, calorizing, sherardizing and other processes requiring electric furnaces, in different plants of that company.

Harry M. Perry, 2816 North Main Street, Los Angeles, Calif.—A circular describes the slack belt idler which is fitted with a special attachment so that it may be mounted on any motor. This consists of a counterweighted pulley and a special attachment for the motor.

Standard Pressed Steel Company, Jenkinstown, Pa.—This folder describes the Gast loose pulley bushing which is a special oiling device that comes into play only when the loose pulley is in operation.

Tide Water Oil Sales Corporation, 11 Broadway, N. Y.—This 60-page book discusses the principles of lubrication, as applied to prime movers, auxiliary equipment and machinery in the power field. The discussion includes the lubrication of transmission elements, motors and various other kinds of equipment, with diagrams and charts to make clear the application.

Miller Rubber Company of New York, Akron, Ohio—This folder describes the special composition Miller mallet (not made of rubber) which is of laminated construction moulded in one piece. The striking qualities are similar to wooden mallets and will not damage, batter up nor bruise.

General Electric Company, Schenectady, N. Y.—Circular 67495. describes the Type FH oil circuit breaker for controlling high capacity from 7,500 to 35,000 volts, 500 to 4,000 amp.

The Standard Electric Tool Company, Cincinnati, Ohio—Circular describes the Standard improved special ½-in. drill which is equipped with universal motor and ball bearings.

Link-Belt Company, Chicago, Ill.—Book 650 shows applications of Link-Belt portable loaders for handling coal, sand, gravel, lime, fertilizer and many other loose materials which have to be loaded from the pile in industrial plants. These vary from small portable belt loaders, gas-engine or motor driven, to large bucket loaders of several hundred tons capacity a day.

Western Electro Mechanical Company, Oakland, Calif.—A 26-page catalog describes the load testing devices for alternating and direct current circuits. These include indicating and graphic alternating current line current test sets, direct current load testing equipment, phantom loads and automatic substation equipment.

Leeds and Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa.—Bulletin 680, reprint, describes the Macbeth illuminometer and gives directions for its operation. This portable equipment is calibrated to read in foot candles.

Mercury Manufacturing Co., 4118 South Halsted Street, Chicago, Ill.—A group of bulletins describes the Mercury tractors and trailers.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis.—Publication 3082, entitled, "Cutler-Hammer Electric Elevator Control Equipment," devotes 48 pages to a description of control equipment of various types and gives standard installations as well as wiring diagrams. Several pages are devoted to a discussion of motors for elevator service, motor fuse and wire rating.

Morse Chain Company, Ithaca, N. Y.—A 48-page booklet entitled "A Chain of Testimonials" contains twenty-two testimonials from that many different concerns which show the experience of users in twenty-six industries for driving twenty-five different types of equipment.

The Truscon Laboratories, Detroit, Mich.—Folders describe Stuccotex, a dry powder, which, when mixed with water, is used for painting cement, stucco and masonry even though the surface is damp and ordinary coverings cannot be used.

Gibb Instrument Company, Bay City, Mich.—A folder entitled, "The Heating Machine," describes some of the electrical heating equipment for welding or brazing.